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ABSTRACT

Presented in this bulletin is the text of the hearing before the Committee on Commerce, United States Senate, ninety-second Congress, concerning coversion of the Nation to a metric system of weights and measures. Bill S. 2483 calls for providing a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to general use of such a system within ten years after the date of enactment of the Act. Accompanying this is joint resolution, S.J. Res. 219, to establish a national policy relating to conversion to the metric system in the United States. The texts of the bill and resolution are given as well as prepared comments from several government agencies. Statements from individual witnesses follow and additional articles, letters, and statements submitted for the record are also recorded. Willian G. Magnuson, Washington, chaired the committee hearings held February 29, and March 1, 1972. (BL)

METRIC CONVERSION

ED 070636

HEARING

BEFORE THE

COMMITTEE ON COMMERCE
UNITED STATES SENATE

NINETY-SECOND CONGRESS

SECOND SESSION

ON

S. 2483

TO PROVIDE A NATIONAL PROGRAM IN ORDER TO MAKE THE INTERNATIONAL METRIC SYSTEM THE OFFICIAL AND STANDARD SYSTEM OF MEASUREMENT IN THE UNITED STATES AND TO PROVIDE FOR CONVERTING TO THE GENERAL USE OF SUCH SYSTEM WITHIN TEN YEARS AFTER THE DATE OF ENACTMENT OF THIS ACT

S. J. Res. 219

TO ESTABLISH A NATIONAL POLICY RELATING TO CONVERSION TO THE METRIC SYSTEM IN THE UNITED STATES

FEBRUARY 29 AND MARCH 1, 1972

Serial No. 92–64

Printed for the use of the Committee on Commerce

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METRIC CONVERSION

TUESDAY, FEBRUARY 29, 1972

U.S. SENATE,
COMMITTEE ON COMMERCE,
Washington, D.C.

The committee met at 11 a.m. in room 5302, New Senate Office Building, Hon. Daniel K. Inouye presiding.

Present: Senators Pastore and Inouye.

OPENING STATEMENT BY SENATOR INOUYE

Senator INOUYE. This morning we begin another chapter of hearings on converting the Nation to a metric system of weights and measures. The advantages of the metric system are numerous: it is inherently simple; conversion is easy between units of length, area, volume, and energy; metric is based upon the decimal system; and perhaps most important, every other industrial nation has converted or is committed to metric conversions.

One hundred and fifty years ago John Quincy Adams, then Secretary of State, prepared a comprehensive report on conversion to the metric system of measurements. Since this first major study, Congress has repeatedly examined the problems of converting to the metric system.

Most recently, in 1968 Congress passed the Metric Study Act, which was introduced by Senator Claiborne Pell. Its purpose was to evaluate the impact on America of the metric trend and to consider alternatives for national policy.

The results of the report of the U.S. metric study are now available and will be discussed today. The U.S. metric study concluded that eventually the United States will join the rest of the world in the use of the metric system as the predominant language of measurement. Rather than drifting to metric with no national plans to help the sectors of our society and guide our relationships abroad, a carefully planned transition in which all sectors voluntarily participate is recommended by the report.

Seldom has an issue been studied at such great length and so comprehensively. Many have suggested that we have studied enough—and that it is now time to take concrete steps to convert to the metric system. The United States is the last major nation to still cling to the obsolete and confusing customary system of measurement. The Nation that has developed the world's most sophisticated technology is

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Staff member assigned to these hearings: Henry E. Lippek.

strapped with using a system of weights and measures that was designed to meet the needs of a feudal society.

A significant portion of our economy has already converted to the metric system. It may well be the case that the issue is no longer whether we shall convert, but whether we should continue our chaotic conversion or embark upon a coordinated, planned program. Should the coordination of our national measurement system emanate from a public or a private body? How long should the conversion period last? Should there be financial assistance or is it more appropriate to let costs lie where they fall? It is our hope that the hearings today will clarify and supplement the information available to Congress on this important topic.

(The bills and agency comments follow:)

92d CONGRESS
1st Session

S. 2483

IN THE SENATE OF THE UNITED STATES

August 6, 1971

Mr. Pell introduced the following bill; which was read twice and referred to the Committee on Commerce

---

A BILL

To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SHORT TITLE

Section 1. This Act may be cited as the "Metric Conversion Act of 1971".

FINDINGS

Sec. 2. The Congress finds that—

(1) the United States is the only major nation of

the world that is not converting to the international metric system;

(2) the adoption of such system would result in new jobs in the United States;

(3) the adoption of such system would enhance our position in world trade markets;

(4) the benefits of conversion would offset the costs of conversion;

(5) conversion to such system would be a stimulus to the economy and to new investment in plant equipment;

(6) the language and tools of our scientific community are already using such system;

(7) a common system of measurement would improve international communication;

(8) the Nation is already heading toward such system slowly and haphazardly;

(9) such system is based on fundamental relationships and is easily understood and would be an aid to our educational system;

(10) small businesses and self-employed craftsmen would benefit from a coordinated conversion program; and

(11) new international standards are currently being developed into such system and the United States is not fully participating in such development.

STATEMENT OF POLICY AND PURPOSE

SEC. 3. (a) It is therefore declared to be the policy of the Federal Government to adopt as the official and standard system of measurement for the United States the international metric system and to provide for converting to the general use of such system within ten years from the date of enactment of this Act.

(b) It is the purpose of this Act to provide for the formulation and initial effectuation of a plan for such conversion, to provide certain assistance to businesses in bearing the cost of such conversion, and to provide for a national education program for the purpose of such conversion.

TITLE I—NATIONAL METRIC PLAN

SEC. 101. (a) The Secretary of Commerce through the National Bureau of Standards shall, within eighteen months after the date of enactment of this Act, develop and report to the President and the Congress a national plan to carry out the policy stated in section 3 (a) of this Act. Such plan—

(1) shall be developed making full use of studies and consultations carried out pursuant to the Act entitled "An Act to authorize the Secretary of Commerce to make a study to determine the advantages and disadvantages of increased use of the metric system in the United States", approved August 9, 1968 (82 Stat. 693);

(2) shall be developed after such additional consultations with other Federal, State, and local government agencies and with foreign governments and international organizations as may be appropriate;

(3) shall be developed with appropriate participation by representatives of United States industry, science, engineering, and labor who may be appointed by the President to advisory boards to assist in the development and implementation of a national plan;

(4) shall be put into effect to the extent possible under existing law after such eighteen-month period, and shall include recommendations for any legislation needed to further effectuate such plan;

(5) shall include proposed regulations, to be made effective pursuant to subsection (b), requiring such conversion in activities of the Federal Government, including procurement, in accordance with an appropriate time schedule;

(6) shall include an appropriate program, including programs and projects carried out pursuant to section 203 of this Act, to educate the public for the purpose of such conversion; and

(7) shall include an appropriate program for the provision of technical assistance to industry and labor for the purpose of such conversion.

(b) The President is authorized to make effective regulations developed pursuant to clause (5) of subsection (a) of this section.

(c) Not later than two years after such plan is put into effect, and annually thereafter, the Secretary shall report to the President and the Congress with respect to (1) progress being made under such plan; (2) cost and benefits being incurred thereunder; and (3) any additional legislation needed to carry out the policy stated in section 3(a).

APPROPRIATIONS AUTHORIZED

SEC. 102. There are authorized to be appropriated such amounts as may be necessary to carry out the provisions of this title.

TITLE II—METRIC CONVERSION ASSISTANCE

TAX ASSISTANCE

SEC. 201. (a) Section 167 of the Internal Revenue Code of 1954 (relating to depreciation) is amended by redesignating subsection (m) as (n) and by inserting after subsection (l) the following new subsection:

"(m) PROPERTY NECESSARY FOR METRIC CONVERSION.—

"(1) USEFUL LIFE.—At the election of the taxpayer, the useful life of property described in paragraph

(2) shall, for purposes of this section other than for purposes of subsection (c), be one-half of the useful life determined without regard to this subsection.

"(2) PROPERTY TO WHICH APPLICABLE.—Paragraph (1) shall apply only to personal property which is—

"(A) manufactured in the United States and substantially all of the component parts of which are manufactured in the United States, and

"(B) placed in service in replacement of other property in order to carry out the requirements of the national plan for metric conversion submitted under the Metric Conversion Act of 1971.

"(3) ELECTION.—An election under paragraph (1) with respect to any property shall be made at such time and in such manner as the Secretary or his delegate prescribes by regulations.

"(4) REGULATIONS.—The Secretary or his delegate shall, after consultation with the Secretary of Commerce, prescribe regulations to carry out the purposes of this subsection."

(b) As soon as practicable after the submission of the national plan for metric conversion under title I of this Act, the Secretary of the Treasury shall submit to the Congress recommendations for additional changes in the Federal income tax laws which he considers necessary or desirable to assist in carrying out the national plan. Before submitting recommendations under this subsection the Secretary of the Treasury shall consult with the Secretary of Commerce and the Secretary of Labor, and with such other officers of the United States and such private individuals and organizations as he deems desirable.

CONVERSION ASSISTANCE TO BUSINESSES AND INDIVIDUALS

SEC. 202. (a) Section 7(b) of the Small Business Act is amended—

(1) by redesignating paragraph (5) (added by Public Law 91-597) as paragraph (6);

(2) by redesignating paragraph (6) (added by Public Law 91-596) as paragraph (7);

(3) by striking the period at the end of paragraph (7) (as redesignated by cause (2) of this subsection) and inserting "; and"; and

(4) by adding after such paragraph (7) a new paragraph as follows:

"(8) to make such loans (either directly or in cooperation with banks or other lending institutions through agreements to participate on an immediate or deferred basis) as the Administration, in consultation with the Secretary of Commerce, determines to be necessary or appropriate to assist any business concern to make changes in its equipment, facilities, or methods of operation to conform to the national plan of metric conversion submitted under the Metric Conversion Act of 1971, if the Administration determines that such concern is likely to suffer substantial economic injury without assistance under this paragraph."

(b) (1) The Administrator of the Small Business Administration is authorized, under terms and conditions prescribed by him, to make grants to individuals to defray nonreimbursable expenses which must be incurred by them for the purpose of acquiring tools or instruments which are necessary to their continued employment in a trade or business and are required as the result of the implementation of the national plan of metric conversion submitted under the Metric Conversion Act of 1971. The amount of any such grant to any individual shall not exceed $2,000.

(2) There are authorized to be appropriated to the Small Business Administration such sums as may be necessary to carry out this subsection.

PUBLIC EDUCATION PROGRAMS

SEC. 203. (a) The Commissioner of Education, in consultation with the Secretary of Commerce, shall make grants to, and contracts with, institutions of higher education, State and local educational agencies, and other public and private nonprofit agencies, organizations, and institutions to develop and carry out programs of public education necessary to carry out the policy stated in section 3 (a) of this Act.

(b) Financial assistance under this section may be made available only upon application to the Commissioner. Any such application shall be submitted at such time, in such form, and containing such information as the Commissioner shall prescribe by regulation and shall be approved only if it—

(1) provides that the activities and services for which assistance is sought will be administered by, or under the supervision of, the applicant;

(2) describes a program which holds promise of making a substantial contribution toward attaining the purposes of this section;

(3) sets forth such policies and procedures as will insure adequate evaluation of the activities intended to be carried out under the application;

(4) sets forth policies and procedures which assure that Federal funds made available under this section for any fiscal year will be so used as to supplement and, to the extent practical, increase the level of funds that would, in the absence of such Federal funds, be made available by the applicant for the purposes described in this section, and in no case supplant such funds.

(5) provides for such fiscal control and fund ac-

counting procedures as may be necessary to assure proper disbursement of and accounting for Federal funds paid to the applicant under this section; and

(6) provides for making an annual report and such other reports, in such form and containing such information, as the Commissioner may reasonably require and for keeping such records, and for affording such access thereto as the Commissioner may find necessary to assure the correctness and verification of such reports.

(c) Applications from local educational agencies for financial assistance under this section may be approved by the Commissioner only if the State educational agency has been notified of the application and been given the opportunity to offer recommendations.

(d) Amendments of applications shall, except as the Commissioner may otherwise provide by or pursuant to regulation, be subject to approval in the same manner as original applications.

(e) Federal assistance to any program or project under this section shall not exceed per centum of the cost of such program or project, including costs of administration, unless the Commissioner determines, pursuant to regulations establishing objective criteria for such determinations, that assistance in excess of such percentage is required in furtherance of the purposes of this section.

(f) There are authorized to be appropriated such amounts as may be necessary to carry out the provisions of this section.

92d CONGRESS
2d Session

S. J. RES. 219

IN THE SENATE OF THE UNITED STATES

March 28, 1972

Mr. Cotton (by request) introduced the following joint resolution; which was read twice and referred to the Committee on Commerce

---

JOINT RESOLUTION

To establish a national policy relating to conversion to the metric system in the United States.

Whereas the use of the metric system to weights and measures in the United States was authorized by the Act of July 28, 1866 (14 Stat. 339) ; and

Whereas the United States was one of the original signatories to the Convention of the Meter (20 Stat. 709), which established the General Conference of Weights and Measures, the International Committee of Weights and Measures, and the International Bureau of Weights and Measures; and

Whereas the metric measurement standards recognized and developed by the International Bureau of Weights and Measures have been adopted as the fundamental measurement standards of the United States and the customary units of weights and measures used in the United States have been since 1893 based upon such metric measurement standards; and

Whereas the Governments of Australia, Canada, Great Britain, India, Japan, New Zealand, and the Union of South Africa have determined to convert, are converting, or have converted to the use of the metric system in their respective jurisdictions; and

Whereas the United States is the only industrially developed nation which has not established a national policy committing itself to and facilitating conversion to the metric system; and

Whereas as a result of the study to determine the advantages and disadvantages of increased use of the metric system in the United States authorized by Public Law 90–472 (82 Stat. 693), the Secretary of Commerce has found that increased use of the metric system in the United States is inevitable, and has concluded that a planned national program to achieve a metric changeover is desirable; that maximum efficiency will result and minimum costs to effect the conversion will be incurred if the conversion is carried out in general without Federal subsidies; that the changeover period be ten years, at the end of which the Nation would be predominantly, although not exclusively, metric; that a central coordinating body be established and assigned to coordinate the changeover in cooperation with all sectors of our society; and that immediate attention be given to public and formal education and to effective United States participation in international standards making: Now, therefore, be it

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the policy of the United States shall be:

(1) to facilitate and encourage the substitution of metric measurement units for customary measurement units in education, trade, commerce, and all other sectors of the economy of the United States with a view to making metric units the predominant, although not exclusive, language of measurement with respect to transactions occurring after ten years from the date of the enactment of this resolution.

(2) to facilitate and encourage the development as rapidly as practicable of new or revised engineering standards based on metric measurement units in those specific fields or areas in the United States where such standards will result in rationalization or simplification of relationships, improvements of design, or increases in economy.

(3) to facilitate and encourage the retention in new metric language standards of those United States engineering designs, practices, and conventions that are internationally accepted or embody superior technology.

(4) to cooperate with foreign governments and public and private international organizations which are

or become concerned with the encouragement and coordination of increased use of metric measurement units or engineering standards based on such units, or both, with a view to gaining international recognition for metric standards proposed by the United States and to encouraging retention of equivalent customary units in international recommendations during the United States changeover period.

(5) to assist the public through information and educational programs to become familiar with the meaning and applicability of metric terms and measures in daily life. Programs hereunder should include:

(a) Public information programs conducted by the Board through the use of newspapers, magazines, radio, television, other media, and through talks before appropriate citizens groups and public organizations.

(b) Counseling and consultation by the Secretary of Health, Education, and Welfare and the Director, National Science Foundation with educational associations and groups so as to assure that the metric system of measurement is made a part of the curriculums of the Nation's educational institutions and that teachers and other appropriate personnel are properly trained to teach the metric system of measurement.

(c) Consultation by the Secretary of Commerce with the National Conference of Weights and Measures so as to assure that State and local weights and measures officials are appropriately informed of the intended metric changeover and are thus assisted in their efforts to bring about timely amendments to weights and measures laws.

(d) Such other public information programs by any Federal agency in support of this resolution which relate to the mission of the agency.

SEC. 2. DEFINITIONS.—For the purposes of this resolution—

(a) The term "metric system of measurement" means the International System of Units as established by the General Conference of Weights and Measures in 1960 and interpreted or modified for the United States by the Secretary of Commerce.

(b) The term "engineering standard" means a standard which prescribes a concise set of conditions and requirements to be satisfied by a material, product, process, procedure, convention, test method, and the physical, functional, performance and/or conformance characteristics thereof.

(c) The term "changeover period" means the length of time for the United States to become predominantly, although not exclusively, metric.

(d) The term "international recommendation" means a recommendation formulated and promulgated by an international organization and recommended for adoption by individual nations as a national standard of measurement.

SEC. 3. There is hereby established a National Metric Conversion Board (hereinafter referred to as the "Board") to implement the policy set out in this resolution.

SEC. 4. The composition of the Board shall be as follows:

(a) Not to exceed twenty-one persons appointed by the President who shall serve at his pleasure and for such terms as he shall specify and who shall be broadly representative of the American society. The President shall designate one of the members appointed by him to serve as Chairman and another to serve as the Vice Chairman of the Board;

(b) Two Members of the House of Representatives who shall not be members of the same political party shall be appointed by the Speaker of the House of Representatives; and

(c) Two Members of the Senate who shall not be members of the same political party shall be appointed by the President of the Senate.

SEC. 5. The Executive Director of the Board shall be appointed by the President and shall be responsible to the

Board for carrying out its responsibilities according to the provisions of this resolution.

SEC. 6. (a) Within twelve months after funds have been appropriated to carry out the provisions of this resolution the Board shall, in furtherance and in support of the policy expressed in section 1 of this resolution, develop and submit to the Secretary of Commerce for his approval and transmittal to the President a comprehensive plan to accomplish a changeover to the metric system of measurement in the United States. If such a plan is approved by the President, he shall transmit it to the Congress. Such plan may include recommendations for legislation deemed necessary and appropriate. In developing this plan the Board shall:

(1) Consult with and take into account the interests and views of the United States commerce and industry, including small business; science; engineering; labor; education; consumers; government agencies at the Federal, State, and local level; nationally recognized standards developing and coordinating organizations; and such other individuals or groups as are considered appropriate by the Board to carry out the purposes of this section.

(2) Consult, to the extent deemed appropriate, with foreign governments, public international organizations, and, through appropriate member organizations, private international standards organizations. Contact with foreign govern-

ments and intergovernmental organizations shall be accomplished in consultation with the Department of State.

(b) Any amendment to an approved plan shall be submitted by the Board to the Secretary and the President under the provisions set out in subsection (a) of this section.

(c) Unless otherwise provided by the Congress, the Board shall have no compulsory powers.

Sec. 7. Upon approval of the plan by the President, the Board shall begin the implementation of the plan, except for those recommendations, if any, which require legislation.

Sec. 8. In carrying out its duties, the Board is authorized to:

(a) enter into contracts in accordance with the Federal Property and Administrative Services Act of 1949, as amended, with Federal or State agencies, private firms, institutions, and individuals for the conduct of research or surveys, the preparation of reports, and other activities necessary to the discharge of its duties;

(b) Conduct hearings at such times and places as it deems appropriate;

(c) establish such committees and advisory panels as it deems necessary to work with the various sectors of the American economy and governmental agencies in the development and implementation of detailed changeover plans for those sectors; and

(d) perform such other acts as may be necessary to carry out the duties prescribed by this resolution.

SEC. 9. (a) Members of the Board who are not in the regular full-time employ of the United States shall, while attending meetings or conferences of the Board or otherwise engaged in the business of the Board, be entitled to receive compensation at a rate of $100 per day, including traveltime, and while so serving on the business of the Board away from their homes or regular places of business, they may be allowed travel expenses, including per diem in lieu of subsistence, as authorized by section 5703 of title 5, United States Code, for persons employed intermittently in the Government service. Payments under this section shall not render members of the Board employees or officials of the United States for any purpose.

(b) The Executive Director of the Board shall serve full time and receive basic pay at a rate not to exceed the rate provided for GS-18 in subchapter III of chapter 53 of title 5, United States Code.

SEC. 10. (a) The Board is authorized to appoint and fix the compensation of such staff personnel as may be necessary to carry out the provisions of this Act.

(b) The Board is authorized to employ experts and consultants or organizations thereof as authorized by section 3109 of title 5, United States Code, compensate individuals so employed at rates not in excess of the rate prescribed for grade 18 of the General Schedule under section 5332 of such title, including traveltime, and allow them, while away from their homes or regular places of business, travel expenses (including per diem in lieu of subsistence) as authorized by section 5703 of said title 5 for persons in the Government service employed: *Provided, however,* That contracts for such employment may be renewed annually.

SEC. 11. Financial and administrative services (including those related to budgeting, accounting, financial reporting, personnel, and procurement) and such other staff services as may be requested by the Board shall be provided the Board by the Secretary of Commerce, for which payment shall be made in advance, or by reimbursement, from funds of the Board in such amounts as may be agreed upon by the Chairman of the Board and the Secretary of Commerce.

In performing these functions for the Board, the Secretary is authorized to obtain such information and assistance from other Federal agencies as may be necessary.

SEC. 12. (a) The Board is hereby authorized to accept, hold, administer, and utilize gifts, donations, and bequests of property, both real and personal, and personal services, for the purpose of aiding or facilitating the work of the Board. Gifts and bequests of money and the proceeds from sales of other property received as gifts or bequests shall be deposited in the Treasury in a separate fund and shall be disbursed upon order of the Board.

(b) For the purpose of Federal income, estate, and gift taxes, property accepted under subsection (a) of this section shall be considered as a gift or bequest to or for the use of the United States.

(c) Upon the request of the Board, the Secretary of the Treasury may invest and reinvest in securities of the United States any moneys contained in the fund herein authorized. Income accruing from such securities, and from any other property accepted to the credit of the fund authorized herein, shall be disbursed upon the order of the Board.

SEC. 13. The Board shall cease to exist no later than ten years after approval by the President of the plan called for by section 6.

SEC. 14. The Board shall submit annual reports of its activities and progress under this joint resolution to the Secretary of Commerce for his approval and transmittal to the President and to the Congress.

SEC. 15. There are hereby authorized to be appropriated such sums as may be necessary to carry out the provisions of this joint resolution. Appropriations to carry out the provisions of this joint resolution may remain available for obligation and expenditure for such period or periods as may be specified in the Acts making such appropriations.

92d CONGRESS
2d Session

H. R. 12555

IN THE HOUSE OF REPRESENTATIVES

January 24, 1972

Mr. McClory introduced the following bill; which was referred to the Committee on Science and Astronautics

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A BILL

To establish a program for the United States to convert to the metric system.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is established, under the general auspices of the Secretary of Commerce, the United States Metric Conversion Coordinating Commission (hereinafter referred to as the "Commission"). The Commission shall have nine members, to be appointed by the President, who shall represent (a) business, (b) labor, (c) education, (d) science, and (e) technology. Each member shall be compensated at the rate of $100 a day each day during which he is engaged in the business of the Commission and shall receive travel expenses while away from his home or regular place of business in the service of the Commission, as a person intermittently employed in the Government service, under section 5703 (b) of title 5, United States Code. Members of Congress or other Federal employees shall not be entitled to such compensation but shall be reimbursed for expenses incurred while in the service of the Commission. Each member shall have a five-year term and may be reappointed by the President.

Sec. 2. The Commission is charged with the responsibility of implementing, with the voluntary participation of every interested sector and group in the United States, the recommendations of the United States metric study, undertaken pursuant to the Act approved August 9, 1968, including—

(1) that the United States change to the international metric system deliberately and carefully;

(2) that this be done through a coordinated national program;

(3) that detailed plans and timetables be worked out, within the guiding framework established and from time to time revised by the Commission, by the various sectors and interests of the society themselves;

(4) that priority be given to an educational pro-

gram to be carried out in the Nation's elementary and secondary schools and institutions of higher learning, as well as with the public at large, designed to enable all Americans to think and work in metric terms;

(5) that the appropriate representatives of American enterprise participate in international standards' activities;

(6) that in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs shall lie where they fall; and

(7) that the target date for full conversion shall be January 1, 1983.

SEC. 3. Each agency, entity, and authority of the Federal Government is authorized and directed to convert to the international metric system as soon as possible, and to cooperate fully with the Commission in all respects.

SEC. 4. On and after January 1, 1983, the sole official system of weights and measures in the United States shall be the international metric system.

SEC. 5. The Commission shall transmit to the President and to each House of Congress an interim report not later than one year after the date of the enactment of this Act. Interim reports shall be likewise submitted each year thereafter until January 1, 1983.

SEC. 6. There are hereby authorized to be appropriated out of any money in the Treasury not otherwise appropriated such amounts as are required to carry out the provisions of this Act.

COMPTROLLER GENERAL OF THE UNITED STATES,
Washington, D.C., October 21, 1971.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate.

DEAR MR. CHAIRMAN: By letter of August 16, 1971, you requested our comments on S. 2483, which, if enacted would be cited as the "Metric Conversion Act of 1971."

While we express no views as to the merits of S. 2483, we offer the following comments on specific provisions of the bill.

The purpose of S. 2483 is to provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this act.

Section 3(b) states that one of the purposes of the bill is to provide for the formulation and initial effectuation of a plan for conversion to the international metric system. Section 101(a) requires the Secretary of Commerce through the National Bureau of Standards to develop and report such national plan to the President and the Congress within 18 months after the date of enactment of the bill. Subsection 101(a)(4) further requires that the plan shall be put into effect to the extent possible under existing law after the 18-month period following enactment of the bill and that the plan shall include recommendations for any legislation needed to further effectuate such plan.

Although the plan is to be reported to the President and the Congress, the bill does not provide for review and approval of the plan and does not state which agency or other body is to be responsible for causing the plan to be implemented and coordinated. The Committee may wish to revise title I to require approval of the plan by the Congress and to designate an agency or other body to be responsible for implementation and coordination of the plan.

Section 3(b) states that another purpose of the bill is to provide certain assistance to businesses in bearing the cost of such conversion. We suggest that "and individuals" be inserted after "businesses" in recognition of assistance to be given to individuals by section 202(b)(1).

Section 202(b)(1) authorizes the Administrator of the Small Business Administration to make grants not exceeding $2,000 to individuals to defray certain non reimbursable expenses necessary to their continued employment in a trade or business. The potential dimensions of this program may be very extensive. Therefore, we suggest that to provide adequate guidance to the Administrator, the bill specify criteria that individuals must meet to qualify for such grants.

The bill contains no requirement in section 203 that the recipient of financial assistance afford access to records by the Comptroller General. We suggest that subsection 203(b) should be appropriately modified to provide such access.

Such authority is provided to Federal grantor agencies and the Comptroller General with respect to grants-in-aid to States pursuant to section 202 of the Intergovernmental Cooperation Act of 1968, 82 Stat. 1101. We recommend that similar authority be provided with respect to recipients of funds below the State level as well as other recipients under the proposed legislation. This could be accomplished by adding another subsection to section 203 of the bill, to read as follows:

"(g) Any agency or organization which receives assistance under this section shall make available to the Commissioner of Education and the Comptroller General of the United States, or any of their duly authorized representatives, for purposes of audit and examination, any books, documents, papers and records that are pertinent to the assistance received by such agency or organization under this section."

Section 203(e) does not state the per centum of program or project costs that Federal assistance shall not exceed.

Attached for your consideration are some editorial changes which we believe should be considered by the Committee.

Sincerely yours,

ROBERT F. KELLER,
Deputy Comptroller General of the United States.

Enclosure.

ATTACHMENT

Editorial changes

On page 2, line 1, insert "has not converted or" after "the world that."

On page 4, line 15, add "of this section" after "subsection (b)."

On page 7, line 16, "cause" should be "clause."

Office of the Deputy Attorney General,
Washington, D.C., October 26, 1971.

Hon. **Warren G. Magnuson,**
Chairman, Senate Commerce Committee,
Washington, D.C.

Dear Senator: This is in response to your request for the views of the Department of Justice on S. 2483, the Metric Conversion Act of 1971.

On the basis of findings that the United States is the only nation in the world not converting to the international metric system, and that benefits would accrue to the United States from the adoption of such a system, the bill would provide for conversion by the United States to the general use of the system as the official and standard means of measurement. To accomplish the purposes of the bill, the Secretary of Commerce would be directed to develop a national plan and to report to the President and Congress within eighteen months after enactment of the bill. Appropriate amendments to provide tax assistance would be made to the Internal Revenue Code and arrangements for public education would be carried out by the Commissioner of Education in consultation with the Secretary of Commerce

Whether this legislation should be enacted involves policy considerations as to which the Department of Justice makes no recommendation.

The Office of Management and Budget has advised that there is no objection to the submission of this report from the standpoint of the Administration's program.

Sincerely,

Richard G. Kleindienst,
Deputy Attorney General.

Federal Trade Commission,
Washington, D.C., February 29, 1972.

Hon. **Warren G. Magnuson,**
Chairman, Committee on Commerce,
Washington, D.C.

Dear Mr. Chairman: This is in response to your request for the Commission's comments on S. 2483, 92d Congress, 1st Session, a bill "To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

Briefly stated, Title I of the subject bill directs the Secretary of Commerce, through the National Bureau of Standards, to develop and implement a coordinated national plan of metric conversion. The plan is to be submitted to Congress within eighteen months of enactment of the bill, and the Secretary of Commerce is authorized to implement the national plan through Government regulations and purchases.

Title II of the bill provides for a program of metric conversion assistance which includes allowing machinery and other equipment purchased for metric conversion to be given, for tax purposes, a useful life of one-half of the usual useful life of the machinery, if it is purchased in the United States. In addition, Title II requires the Commisioner of Education, in consultation with the Secretary of Commerce, to make grants to, and contracts with, institutions of higher education, and State and local educational agencies, to develop and carry out programs of public education necessary to carry out the adoption of the international metric system as the official and standard system of measurement for the United States.

The Commission is unaware of any indictaors which could be used to measure the impact of conversion to the metric system on United States trade practices. However, such a conversion is unlikely to have a significant impact on the Commission's ability to perform its statutory duties, although it will require, as it will with respect to the nation in general, an educational process. The desirability of enacting the subject bill, in the opinion of the Commission, can best be determined by those responsible for its implementation, and those who would be more substantially affected thereby. Consequently, the Commission defers to the views of the Department of Commerce and other agencies more likely to be substantially affected.

By direction of the Commission.

Charles A. Tobin, *Secretary.*

UNITED STATES POSTAL SERVICE,
LAW DEPARTMENT,
Washington, D.C., May 24, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
United States Senate,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in reply to your request for a report on S. 2483, a bill to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the enactment of the bill.

This report is concerned with sections 1 through 3 and title I of the bill, which would direct the Secretary of Commerce through the National Bureau of Standards to develop and implement a plan for conversion assistance to the public through tax incentives and other means, would not affect the Postal Service.

The Postal Service does not object to conversion to the metric system. Although conversion would undoubtedly be expensive and troublesome for the Postal Service (as for other very large enterprises) during the period of transition to the new system, these short-term detriments would appear to be heavily outweighed by the general long-term benefits that could be expected to result.

Sincerely,

ROGER P. CRAIG,
Deputy General Counsel.

U.S. ATOMIC ENERGY COMMISSION,
Washington, D.C., May 25, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate.

DEAR SENATOR MAGNUSON: The Atomic Energy Commission is pleased to reply to your letter of September 7, 1971, requesting our views on S. 2483, a bill "[t]o provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

The Atomic Energy Commission supports the objective of standardization on the basis of the international metric system of measurement, and we believe that a period of ten years is a reasonable time frame within which to accomplish such conversion in this country. On the specifics of this bill we defer to the views of the departments and agencies which would be more directly involved in the administration of this effort.

This bill, to be cited as the "Metric Conversion Act of 1971", would declare it to be the policy of this Government to adopt the international metric system as the "official and standard system of measurement for the United States" and to provide for the conversion to such system within ten years from the bill's enactment. To effectuate this policy, the Secretary of Commerce, acting through the National Bureau of Standards, would formulate a national plan of conversion and report such plan to the President and Congress within eighteen months from the time of enactment of this proposed legislation. The plan would be developed making use of the results of the comprehensive Metric Study authorized by the Congress in 1968 and carried out by the Secretary of Commerce.

In the course of devising this plan, the Secretary of Commerce would consult with other government agencies, as well as foreign governments and international organizations, and would also provide for appropriate participation by advisory boards consisting of representatives of "industry, science, engineering, and labor" who are appointed by the President for the purpose of assisting in this effort. Following the initial eighteen-month period, the plan would be placed into effect "to the extent possible under existing law" and would include recommendations for any further enabling legislation deemed necessary for its effectuation. Another essential part of this plan would be the formulation of proposed regulations providing for such conversion in the activities of the Federal Government. The President would be authorized to make these regulations effective.

Under Section 203 of the bill the Commissioner of Education, in consultation with the Secretary of Commerce, would be obligated to make such grants and enter into such contracts with institutions of higher education, State and local education agencies, and other public and private nonprofit organizations for the development and conduct of "programs of public education" as are necessary to accomplish the stated policy of this bill.

The development of a program of technical assistance to industry and labor for the purpose of conversion would also be made a part of the plan. In furtherance of this purpose, Title II of the bill would amend the Internal Revenue Code to permit accelerated depreciation of U.S. manufactured machinery and equipment placed into service for replacement purposes as a result of the conversion. Following submission of the national plan of conversion, the Secretary of the Treasury would be required to submit to Congress any additional changes in the Federal income tax laws which are necessary or desirable to assist in carrying out the plan. In addition, the bill would amend the Small Business Act to authorize the Administrator of the Small Business Administration to make loans to assist business concerns which are "likely to suffer substantial economic injury" as a result of the conversion. The Administrator of the SBA would also be authorized to make maximum grants of $2,000 to individuals in orders to defray nonreimbursable expenses which must be incurred as a consequence of the conversion for the purpose of acquiring tools or instruments necessary to their continued employment in a trade or business.

Not later than two years after the bill becomes effective the Secretary of Commerce would be required to begin submitting annual reports to the President and Congress concerning the progress being made under the plan, the costs and benefits being realized under it, and any additional legislation believed necessary to carry out the plan.

From AEC's standoint, the impact of converting to the metric system would be felt to varying degrees. Our basic research effort already generally employs the metric concept, since it is the international language of the physical and biological sciences. On the other hand, in those programs which are largely engineering in nature and in which measurement is usually in English, specialized, or mixed units, the conversion effort would be considerably greater, with attendent costs and problem areas. Nevertheless, we believe that in the long run the benefits to be realized by using a simpler and uniform system of measurement would far outweigh the disadvantages inherent in conversion to the system.

The Office of Management and Budget has advised that while there is no objection to the presentation of this report, enactment of the joint resolution proposed by the Department of Commerce (S.J. Res. 219), in lieu of S. 2483, would be consistent with the Administration's objective.

Sincerely,

JOHN A. ERLEWINE,
Deputy General Manager.

DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
Washington, D.C. May 26, 1972.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate.

DEAR MR. CHAIRMAN: This is in response to your request for our views on S. 2483, "To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

The Department favors legislation to implement metric conversion, but defers to the Department of Commerce as to the form of such legislation.

Increased involvement in international affairs and the world-wide trend to usage of the metric system have already necessitated more extensive use of it in agricultural trade.

Universal adoption of the system would bring uniformity with definite long-run advantages to agriculture. For example, marketing efficiency would improve from the use of metric units. Numerous conversions of weights and measures are now required for agricultural products which are sold in units such as pounds, gallons, and bushels, and containers of various shapes and sizes. Under the metric system conversions would be reduced and simplified. Full adoption of the metric system would eventually eliminate confusion and errors currently resulting from use of both the "English" system and the metric system.

We believe that some improvement in efficiency is possible in the use of the "English" system. However, the disruption among those involved would be of such magnitude that direct conversion to the metric system is preferred.

The Office of Management and Budget advises that while there is no objection to the presentation of this report, the enactment of the joint resolution proposed by the Department of Commerce (S.J. Res. 219), in lieu of S. 2483, would be consistent with the Administration's objectives.

Sincerely,

J. PHIL CAMPBELL, *Under Secretary.*

EXECUTIVE OFFICE OF THE PRESIDENT,
OFFICE OF EMERGENCY PREPAREDNESS,
Washington, D.C. May 26, 1972.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in reply to your request for comments of this Agency concerning S. 2483, 92nd Congress, a bill cited as the "Metric Conversion Act of 1971."

The Office of Emergency Preparedness strongly feels that the long-range benefits of conversion to the metric system would far outweigh any temporary difficulties that might occur during the transition period.

As to whether the subject bill is the best approach for accomplishing the transition to the metric system, however, the Office of Emergency Preparedness defers to agencies that would be more directly involved in its implementation.

The Office of Management and Budget advises that while it has no objection to the submission of this report, enactment of the Joint Resolution proposed by the Department of Commerce (S.J. Res. 219), in lieu of S. 2483, would be consistent with the Administration's objectives.

Sincerely,

G. A. LINCOLN, *Director.*

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION,
Washington, D.C., May 26, 1972.

HON. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, Washington, D.C.

DEAR MR. CHAIRMAN: This is in further reply to your request for the comments of the National Aeronautics and Space Administration on the bill S. 2483, "To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

S. 2483 would make it the official policy of the United States to adopt the metric system as the official and standard system of measurement for the United States, and would provide for converting to the general use of such system within ten years.

Under this bill the Secretary of Commerce would be given the responsibility for developing a national plan for conversion to the metric system with the requirement that he coordinate fully with agencies of the Federal, state and local governments, foreign governments and international organizations, educational institutions, and representatives of industry, science, and labor.

Assistance to businesses for such conversion would be made available through certain preferential tax treatments and through the the Small Business Administration. Assistance to educational institutions to implement the policy of conversion to the metric system would be made available through the Commissioner of Education.

The National Aeronautics and Space Administration has already implemented extensive use of the metric system and endorses the full conversion to metric measurement.

For the reasons that are listed below, the joint resolution proposed by the Department of Commerce (S.J. Res. 219) is preferred over S. 2483.

1. S.J. Res. 219 would create a National Metric Conversion Board of 25 persons, 21 appointed by the President plus two members of the House of Representatives and two members of the Senate. This Board, which could have very broad representation, would be responsible for planning and carrying out the metric conver-

sion. S. 2483 merely directs the Secretary of Commerce to prepare the plan with the help of the National Bureau of Standards.

2. S.J. Res. 219 would authorize the Board to begin implementation of the plan upon approval by the President. S. 2483 merely states that the plan shall go into effect, to the extent possible under existing law, after an 18-month period.

3. S.J. Res. 219 would authorize the Board to conduct public information programs. It would authorize consultation by the Secretary of HEW and the Director, National Science Foundation with educational associations, all of which would promote better public understanding of the metric system.

4. S.J. Res. 219 would authorize consultation by the Secretary of Commerce with the National Conference of Weights and Measures so as to assure that state and local officials are appropriately informed and assisted in their efforts to bring about conversion.

In view of the foregoing and other provisions, we believe that S.J. Res. 219 is a more carefully constructed instrument; it sets forth the national policy clearly and it provides sound, practical means for implementing that policy.

In addition, S. 2483 contains provisions that would have the effect of subsidizing certain groups affected by the conversion. It provides for tax assistance, loans, and grants to small businesses, and educational institutions and others to help defray some of the non-recurring expenses of conversion. In addition to the substantial cost to the government, these provisions could involve an unwarranted amount of regulation and litigation. S.J. Res. 219 makes no provision for subsidies, but rather adopts the strong recommendation of the Metric System Study that the conversion be carried out in general without federal subsidies. S.J. Res. 219 would authorize that funds be appropriated to cover the expenses of the personnel and activities of the Metric Conversion Board.

The Office of Management and Budget has advised that, while there is no objection to the submission of this report to the Congress, enactment of S.J. Res. 219 in lieu of S. 2483 would be consistent with the Administration's objectives.

Sincerely,

H. DALE GRUBB,
Assistant Administrator for Legislative Affairs.

UNITED STATES DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., May 30, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, Washington, D.C.

DEAR MR. CHAIRMAN: Your Committee has requested the views of this Department on S. 2483, a bill "To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

Although we would have no objection to enactment of legislation to implement metric conversion we defer to the views of the Department of Commerce for the reasons cited herein.

S. 2483 provides that the Secretary of Commerce, through the National Bureau of Standards, shall develop and report to the President and the Congress, within 18 months, a national plan to carry out the declared policy of the Federal Government to adopt the international metric system and to convert to the general use of such system within 10 years. The national metric plan would be put into effect to the extent possible under existing law, and the President would be authorized to make effective regulations requiring conversion in the activities of the Federal Government. In addition, necessary legislation on conversion would be considered by the Congress. The proposed legislation also provides for metric conversion tax assistance, conversion assistance to businesses and individuals by means of direct or guaranteed loans, and for programs of public education.

Public Law 90-472 (82 Stat. 693) authorized the Secretary of Commerce to make a study to determine the advantages and disadvantages of increased use of the metric system in the United States. The law directed the Secretary to submit within three years after its enactment a full and complete report of his findings together with such recommendations as he considered appropriate and to the best interests of the United States.

Pursuant to this directive, the Secretary of Commerce issued a report in July 1971, which, in substance, recommended that the United States adopt the international metric system through a coordinated national plan within a period of ten years.

It is our understanding that the Department of Commerce has submitted draft legislation for submission to the Congress which would implement its recommendations for a national policy in relation to conversion to the metric system. That legislation has been introduced as S. J. Res. 219.

It is for this reason that we defer to the views of the Department of Commerce as to the need for and advisability of enactment of S. 2483.

The Office of Management and Budget has advised that, while there is no objection to the presentation of this report, enactment of S. J. Res. 219 in lieu of S. 2483 would be consistent with the Administration's objective.

Sincerely yours,

HOLLIS M. DOLE,
Assistant Secretary of the Interior.

GENERAL SERVICES ADMINISTRATION,
Washington, D.C., May 30, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
Washington, D.C.

DEAR MR. CHAIRMAN: Your letter of September 7, 1971, requested the views of the General Services Administration on S. 2483, 92nd Congress, a bill "To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

The bill would declare it to be the policy of the Federal Government to adopt the international metric system as the official and standard system of measurement for the United States and to convert to general use of the system within ten years. The bill provides for the formulation of a plan for conversion, assistance to businesses in bearing the costs, and a national education program on the subject.

Within 18 months, the Secretary of Commerce, through the National Bureau of Standards, would develop a national plan making full use of studies conducted under Public Law 90-472, approved August 9, 1968 (82 Stat. 693). In GSA's final report to the Secretary of Commerce in connection with that study, we stated on August 26, 1970, "A nationally planned program to increase the use of the metric system would forestall the confusion to consumers which an unplanned increase would create, but would introduce the practical difficulty of educating the public in the use of metric units. A ten year period for this program would appear to be reasonable." S. 2483 is consistent with that statement.

We concur in the findings listed in section 2 of the bill, and endorse its purpose as consistent with sound management principles and essential to remaining competitive in international commerce.

As to costs, we estimated in the above-mentioned report to the Secretary of Commerce that the cost to GSA would be approximately $1 million during the transition period, and that if the conversion included metric based engineering standards as well as metric measurement units, an annual cost of $100,000 for an indefinite period after the transition period, due to the need for dual inventories of replacement parts and equipment.

The Office of Management and Budget has advised that while there is no objection to the submission of this report to your Committee, enactment of the Joint Resolution proposed by the Department of Commerce (S. J. Res. 219), in lieu of S. 2483, would be consistent with the Administration's objectives.

Sincerely,

HAROLD S. TRIMMER, Jr.,
Assistant Administrator.

OFFICE OF THE SECRETARY OF TRANSPORTATION,
Washington, D.C., June 2, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your request for Departmental comments on S. 2483, a bill:

"To provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

Title I would require the Secretary of Commerce, acting through the National Bureau of Standards, to develop a plan for implementing the metric system as the official system of measurement for the United States. It would be required that the plan make full use of studies and consultations carried out pursuant to P.L. 90-472, an act which authorized the Secretary of Commerce to make a study to determine the advantages and disadvantages of increased use of the metric system in the United States.

Title II provides for a program of metric conversion assistance. It would allow machinery and other equipment purchased for metric conversion to be given a useful life of one-half the usual useful life of machinery for tax purposes, provided the machinery is purchased within the United States. As a result of the metric conversion, the Small Business Administration would be authorized to make grants not to exceed $2,000, to individuals who must acquire new tools or instruments; loans would also be authorized for small businesses which are likely to suffer substantial economic injury without assistance. Finally, the U.S. Office of Education would be authorized to undertake public education programs deemed necessary to carry out the policy of the Act.

While the adoption of the international metric system would provide an atmosphere in which the United States could trade in world markets on an equal footing with other nations, not handicapped by standards that are incompatible with our own, the implementation of such a system would be of immediate concern to the Department of Commerce. We, therefore, defer in our comments on S. 2483 to that Department.

The Office of Management and Budget has advised that there is no objection to the submission of this report for the consideration of the Congress, and that enactment of the Joint Resolution proposed by the Department of Commerce (S.J. Res. 219) in lieu of S. 2483, would be consistent with the Administration's objectives.

Sincerely,

JOHN W. BARNUM, *General Counsel.*

DEPARTMENT OF THE AIR FORCE,
Washington, D.C., June 6, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
U.S. Senate.

DEAR MR. CHAIRMAN: Reference is made to your request to the Secretary of Defense for the views of the Department of Defense with respect to S. 2483, 92nd Congress, a bill "Metric Conversion Act of 1971." The Secretary of Defense has assigned to the Department of the Air Force the responsibility for expressing the views of the Department of Defense.

The purpose of S. 2483 is to provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act.

The Department of the Air Force, as the executive agent for metrication, in conjunction with the DOD Metric Steering Committee, and on behalf of the Department of Defense, recognizes that any decision to adopt the metric system of measurement is national in scope. Consequently, we have not taken a position either for or against such conversion. It is noted, however, that directed conversion would have a significant impact on budget and operational considerations within the Department of Defense. This is particularly noteworthy during the current period of fiscal constraints when the limited funds available must be applied to the most urgent needs of National security.

The estimated costs associated with conversion could be high. However, we assume that conversion would be made only if benefits exceed costs.

This report has been coordinated within the Department of Defense in accordance with procedures prescribed by the Secretary of Defense.

The Official of Management and Budget advises that, while there is no objection to the presentation of this report for the consideration of the Committee, enactment of the Joint Resolution proposed by the Department of Commerce (S.J. Res. 219), in lieu of S. 2483, would be consistent with the Administration's objectives.

Sincerely,

PHILIP N. WHITTAKER,
Assistant Secretary of the Air Force (Installation and Logistics).

NATIONAL SCIENCE FOUNDATION,
Washington, D.C., June 9, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce,
Washington, D.C.

DEAR MR. CHAIRMAN: This is in response to your letter of August 16, 1971, requesting the comments of the National Science Foundation on S. 2483, the Metric Conversion Act of 1971.

The Foundation strongly supports the enactment of legislation for this purpose. As Section 2(b) recognizes, the American scientific community, like the world scientific community in general, has used the metric system for many years, and most basic engineering research in the United States is also reported in metric units (although engineering calculations are usually made in English units). We feel that the country and the world would be better off with uniform systems of weights and measures.

While the National Science Foundation clearly favors adoption of the metric system, it has no direct responsibilities assigned to it under the legislation. Accordingly, we would defer to the views of the National Bureau of Standards and the Department of Commerce on this matter.

We would like to make one observation, however. Adult community education through, for example, radio and television spots and displays in public buildings and at public events is very important. The problems of metric conversion are not essentially scientific but rather involve the adjustment of the American public in general and American business in the ways and means of the system. A Gallup Poll reported in the Washington Post of Sunday, October 3, 1971, indicated that more than half of the American public does not even know what the metric system is, and those who were aware of the metric system divided evenly on its adoption. The American scientific community will not be significantly affected by the conversion of the United States to the metric system (or the failure to do so), but the American public and American business will be greatly affected through such a conversion. Any metric conversion legislation must be clearly and specifically directed to the problems which these groups will undoubtedly encounter.

The Office of Management and Budget has advised us that, while there is no objection to the submission of this report, enactment of the Joint Resolution proposed by the Department of Commerce (S.J. Res. 219), in lieu of S. 2483, would be consistent with the Administration's objectives.

Sincerely yours,

R. L. BISPILINGHOFF,
(For H. Guy Stever, Director).

DEPARTMENT OF STATE,
Washington, D.C., June 22, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, U.S. Senate.

DEAR MR. CHAIRMAN: In your letter of August 16, 1971, you requested the comments of the Department of State on S. 2483, a bill "to provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act."

The Department of State endorses the basic objective of achieving a planned, gradual transition to the predominant use of the international metric system in the United States. Adoption of the international metric system would facilitate the exportation of manufactured commodities from the United States by increasing the compatibility between United States manufacturing practices and overseas market requirements. The Department considers, however, that Senate Joint Resolution 219 represents the most appropriate approach to achieving this objective.

Title II of S. 2483 provides for government assistance to private business in the form of accelerated depreciation schedules, other tax benefits and loans and grants to businesses and individuals. S.J. Res. 219, on the other hand, indicates that maximum efficiency will result and "minimum costs for conversion will be incurred if the conversion is carried out in general without Federal subsidies." The Department is in agreement with the latter view.

One aspect of the proposed tax benefits in Section 201 of S. 2483 raises particular trade policy problems. This is the provision that the benefits would apply only to property manufactured in the United States and substantially all the components of which are manufactured in the United States. In various commercial agreements, including the General Agreement on Tariffs and Trade, the United States is committed to the principle that imported products shall be accorded treatment no less favorable than that accorded like products of national origin with respect to laws and regulations affecting their use. If the United States were to exclude imported equipment from tax benefits for property used in carrying out the metric conversion program, other nations would regard the exclusion as a new non-tariff barrier to trade. This development would impede efforts being made by the United States to reduce or eliminate non-tariff barriers around the world that serve to impede the development of United States exports. In addition, it is possible that countries whose trade was adversely affected by the measure would seek to retaliate against imports from the United States.

The Office of Management and Budget advises that from the standpoint of the Administration's program there is no objection to the submission of this report and that enactment of S.J. Res. 219 in lieu of S. 2483 would be consistent with the Administration's objectives.

Sincerely,

DAVID M. ABSHIRE,
Assistant Secretary for Congressional Relations.

THE SECRETARY OF COMMERCE,
Washington, D.C., February 29, 1972.

Hon. SPIRO T. AGNEW,
President of the Senate, Washington, D.C.

DEAR MR. PRESIDENT: Enclosed are four copies of a draft Joint Resolution "To establish a national policy relating to conversion to the metric system in the United States"

together with a statement of purpose and need in support thereof.

The Department of Commerce urges enactment by the Congress of this Joint Resolution for the reasons set forth in the statement of purpose and need.

We have been advised by the Office of Management and Budget that enactment of this draft Joint Resolution would be consistent with the Administration's objectives.

Sincerely,

KARL E. BAKKE,
Acting Secretary of Commerce.

Enclosures.

DEPARTMENT OF COMMERCE—STATEMENT OF PURPOSE AND NEED—S.J. RES. 219

In view of the increased use of the metric system of measurement in international trade and its adoption by virtually every major nation in the world, the Congress, by Public Law 90-472 in 1968, directed the Secretary of Commerce to undertake a three year study of the metric system so as to determine its impact on the United States. The Secretary's final report, submitted in July 1971, concludes that eventually the United States will join the rest of the world in the use of the metric system as the predominant common language of measurement. Rather than drifting to metric with no national plan to help the sectors of our society and guide our relationships abroad, a carefully planned transition in which all sectors participate voluntarily is preferable. Such a plan would assist these sectors in adjusting to the metric system more efficiently, more effectively, and more economically.

As a means of providing an effective changeover to the metric system, there is herewith proposed a Joint Resolution which would establish a national policy for converting to the metric system in the United States. The Resolution, after describing previous United States involvement in metric system measurement activities, declares that the policy of this Nation shall be to facilitate and encourage the substitution of the metric system of weights and measures in place of the current customary measurement units in education, trade, commerce and all other sectors of the economy. It is intended that metric units would become the predominant, though not exclusive, language of measurement within a period of ten years from the date of this Resolution's enactment.

Another important part of this policy pertains to the retention in new metric language standards of those U.S. engineering designs, practices, and conventions that are internationally accepted or embody superior technology. It would also be this country's intention to cooperate with foreign governments and private international organizations which are concerned with the encouragement and coordination of the increased use of metric measurement units or engineering standards based on such units. Finally, it would be the policy to conduct extensive publication information and educational programs through use of the public media so as to familiarize the public with the meaning and applicability of metric terms and measurements in their daily life. In addition, the Secretary of Health, Education, and Welfare and the Director of the National Science Foundation are authorized to counsel and consult with educational associations and groups so as to assure that the metric system of measurement is made a part of the curricula of the Nation's educational institutions and that teachers and other personnel are properly trained to teach the metric system of measurement. Further, the Secretary of Commerce is authorized to consult with the National Conference of Weights and Measures so as to assure that State and local weights and measures officials are appropriately informed of the intended metric changeover and are thus assisted in their efforts to bring about timely amendments to weights and measures laws.

To carry out thee policies, the Resolution would establish a National Metric Conversion Board composed of not more than 21 distinguished private citizens appointed by the President and 4 members of the Congress selected by the Speaker of the House of Representatives and the President of the Senate. One of the initial functions of this Board would be to develop and submit to the Secretary of Commerce, for his approval and transmittal to the President, a comprehensive plan to accomplish the changeover to the metric system of measurement in the United States. This plan shall be submitted to the Secretary within 12 months after funds have been appropriated to carry out the Resolution's provisions. The Resolution would give no compulsory powers to the Board and the changeover proposed by the Board in its plan would be entirely voluntary.

In developing the plan, the Board would be required to consult with United States commerce and industry, including small business, science, engineering, labor, education, consumers, nationally recognized standards developing and coordinating organizations, government agencies at the Federal, State, and local level as well as, where appropriate, with foreign governments and public international organizations. Upon the approval of the plan by the President, it would be submitted to the Congress. The Board, after approval by the President, would begin implementation of the plan except for those recommendations in the plan, if any, which would require legislation. The life of the Board would be no longer than 10 years after its plan is approved by the President.

The Resolution makes provision for an Executive Director and a staff to assist the Board. In carrying out its duties, the Board would be authorized to enter into contracts, conduct hearings, establish committees and advisory panels, and perform such other acts as may be necessary to implement the functions prescribed by the Resolution. Annual reports of its progress would be submitted by the Board to the Secretary of Commerce for his approval. The Secretary would, in turn, forward such reports to the President for his approval and transmittal to the Congress.

The Resolution would authorize the appropriation of such sums as may be necessary to carry out its provisions. The appropriations would be available for obligation and expenditure for such periods as specified in the Acts making such appropriations.

It is estimated that exenditures in the first full year of operation would approximate three million dollars.

Federal Trade Commission,
Washington, D.C., May 8, 1972.

Hon. Warren G. Magnuson,
Chairman, Committee on Commerce,
U.S. Senate,
Washington, D.C.

Dear Mr. Chairman: This report is in response to your request for the Commission's views on S.J. Res. 219, 92d Congress, 2d Session, a joint resolution "To establish a national policy relating to conversion to the metric system in the United States."

This resolution calls for the establishment of a National Metric Conversion Board, having not to exceed twenty-one members. One of the initial duties would be to submit to the Secretary of Commerce, within twelve months after funds have been appropriated, a comprehensive plan to carry out the conversion to the metric system. Presidential approval of the plan would be required, whereupon it would be summitted to Congress. Implementation of the plan would commence after Presidential approval, except for those aspects requiring legislation.

The resolution authorizes the Board to enter into contracts, conduct hearings, and perform other functions necessary to carry out its duties. The Board would be required to submit annual reports to the Secretary of Commerce concerning its progress in accomplishing the change. In addition, the resolution makes it the policy of the United States to conduct public information and educational programs to familiarize the public with the metric system, and to insure that the metric system is included in the curricula of educational institutions.

Despite the absence of any means for determining the impact of conversion to the metric system on United States trade practices, the Commission does not believe that such a conversion is likely to have a significant impact on its ability to perform its statutory duties in relation to those practices. The merits of S.J. Res. 219 can best be evaluated by the agencies which would be responsible for its implementation, and those which would be more substantially affected thereby. Consequently, the Commission defers to the views of such agencies.

By direction of the Commission.

In granting clearance of this report the Office of Management and Budget suggested that the Committee be advised as follows:

"The Federal Trade Commission has been advised by the Office of Management and Budget that while there is no objection to the submission of this report, the enactment of S.J. Res. 219 would be consistent with the Administration's objectives."

Charles A. Tobin, *Secretary.*

The White House,
Washington, D.C., May 4, 1972.

Hon. Warren G. Magnuson,
Chairman, Committee on Commerce,
Washington, D.C.

Dear Mr. Chairman: This is in response to your request for our views on S.J. Res. 219, to establish a national policy relating to conversion to the metric system in the United States.

The language of S.J. Res. 219 is the language proposed by the Administration for a Joint Resolution on conversion to the metric system. My office was consulted in the drafting of this language, concurs in it, and therefore fully supports the passage of S.J. Res. 219.

The Office of Management and Budget has advised that enactment of S.J. Res. 219 would be consistent with the Administration's objectives.

Sincerely,

Virginia H. Knauer,
Special Assistant to the President
for Consumer Affairs.

National Science Foundation,
Washington, D.C., June 9, 1972.

Hon. Warren G. Magnuson,
Chairman, Committee on Commerce,
Washington, D.C.

Dear Mr. Chairman: This in response to your letter of April 17, 1972, requesting the comments of the National Science Foundation on S.J. Res. 219, "To establish a national policy relating to conversion to the metric system in the United States."

The Foundation favors the enactment of legislation looking toward adoption by the United States of the international metric system of weights and measures, and it generally supports the provisions of S.J. Res. 219.

We support in particular the authorization of the National Metric Conversion Board to conduct extensive public information and educational programs through the use of the public media so as to familiarize the public with the metric system. A Gallup Poll reported in the Washington Post of Sunday, October 3, 1971, indicated that more than half of the American public does not know what the metric system is, and those who were aware of the metric system divided evenly on its adoption. This poll is an indication of the degree of public confusion and possible resistance which will result at the initiation of a conversion period. An extensive public information and education program is vital to overcome this. For our part, while we would be happy to provide educational units with whatever counseling and other advice they may seek under section 1(5)(b) of the resolution if it would be useful, it is difficult to see what specific advice could be given or would be needed that is not already available or generally known.

The Office of Management and Budget has advised us that enactment of S.J. Res. 219 would be consistent with the Administration's objectives.

Sincerely yours,

R. L. Bispilinghoff,
(For H. Guyford Stever, Director).

Senator Inouye. Our first witness today is the distinguished Senator from Rhode Island, the Honorable Claiborne Pell, who has long led the fight in the Senate for metric conversion.

I think it is very appropriate that Senator Pell be the leadoff witness as the authority on the metric study bill. It should be noted that Senator Pell introduced his first metric bill in 1962. Of the many Senators who have been interested in the metric system, he has been the one who long ago looked ahead to this problem. So it is my pleasure and great delight to welcome to this committee a man who has had the foresight to anticipate this very important subject of metric conversion.

Welcome, sir.

STATEMENT OF HON. CLAIBORNE PELL, U.S. SENATOR FROM RHODE ISLAND

Senator Pell. Thank you very much, Senator Inouye, and members of Commerce Committee. I thank you particularly for your warm friendship and hospitality in working out this hearing and permitting me to be the leadoff witness. I am deeply grateful.

In past months the executive branch has chided the Congress for not acting on some proposals that have been before us a little over a year.

Well, we are discussing today a proposal that the executive branch first put before us over 180 years ago, the question of metric conversion.

When Thomas Jefferson suggested to the Congress that it might fulfill its constitutional responsibilities for setting standards of weights and measures by giving consideration to the French metric system, metric conversion had somewhat of a revolutionary sound to it. Guilt by association you might say.

After all, the metric system was the result of an effort by French revolutionaries to purge the country of any remaining feudal vestiges.

How strange it might seem now to Thomas Jefferson and to John

Quincy Adams, who also brought the matter before Congress, as the chairman has pointed out, that the United States is still inching along with the customary system—the so-called imperial system of measures—even after the country of Great Britain, the former imperial nation that gave the imperial system its name, has gone metric. In fact, as metric studies have pointed out, there are few countries left without the metric system; a few countries in the Pacific, the Near East, Africa, and the United States.[1]

I have often wondered whether our country's long-time adherence to the imperial system of weights and measures, after more than 90 percent of the world's nations have gone metric, represents a psychological vestige of the spirit of "manifest destiny" in the American mind.

Do we still think that our economic power is so great that we can maintain in the world an obsolete and awkward system of weights and measures? I would hope not.

Imperialism is dead. History has taught and is teaching us that.

The time is long overdue, in my view, for this country to purge itself of these remnants of feudal vestiges and go metric.

In 1967 I worked with members of this distinguished committee to obtain passage of Public Law 90–472, which established a broad-ranging study as to the advantages and disadvantages to the United States if we should convert to a predominantly metric system—that is the "systeme internationale" of weights and measures.

This study law requires the Secretary of Commerce to do four things—

1. To determine the impact of the increasing worldwide use of metric on the United States;
2. To appraise the desirability and practicality of widening the use of metric weights and measures in the United States;
3. To study the feasibility of maintaining customary engineering standards; and
4. To evaluate the costs and benefits of alternative courses of action which may be feasible to our Nation.

The Secretary's study—which was an excellent job—found that the increasing use of metric in the world makes metric conversion in the United States inevitable, that it was desirable for the United States to convert to metric, and that the benefits of conversion on a planned basis far exceed the costs.

Not to my surprise, the Secretary of Commerce found that the question was not whether the United States should decide to go metric, but how and when our country should go metric.

The metric system of measures, or the systeme internationale as it is now known, has been a legal system of measures in the United States since 1866. So just to say that the metric system will be legal is not enough. We have had that for some time, we have to go a bit further.

It is a system that is now being used by scientists, engineers, and educators throughout the country. Metric is used as the language of our astronauts on the moon, as the language of our athletes at international meets, and as the language of our unfortunate soldiers on the battlefields of Southeast Asia.

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[1] The Nations still clinging to their own or to the "English System" are: Burma, Gambia, Ghana, Liberia, Muscat and Oman, Sierra Leone, Southern Yemen, Tonga, Trinidad and the United States.

Three of the six units of the systeme internationale are already utilized in the customary or imperial system—that is, the second for time; the amp, the watt, and the hertz for electrical units; and the candela for luminous intensity.

More than 11 percent of manufacturers, according to the metric study, are already using metric. American firms which are part of multinational corporations having an estimated annual output of $225 billion are already utilizing metric with their foreign products. To do this, many of these firms, like Bostitch in my own State, just maintain dual inventories.

A recent Gallup poll indicated there is increasing public support for complete metric conversion; and the survey of the U.S. metric study indicated that more than 93 percent of manufacturers favor a coordinated plan for metric conversion.

Today I am appearing before you to ask, not that the Nation change its course with regard to metric conversion—we are already drifting toward that system—but that the country should hoist sail and move under full sail toward metric conversion. I believe we should move ahead now with a deliberate national plan rather than continue our present tillerless, drifting, laissez faire course toward metric conversion.

Congress is specifically designated by the Constitution as being responsible for establishing a system of weights and measures for the Nation. I do not think we should shirk that responsibility. We cannot continue to take a schizophrenic approach toward our system of weights and measures.

To my mind, we should take the lead this year and pass legislation establishing a point in time when the metric system of weights and measures, with certain exceptions, will be the only legal system of measures in the United States.

Every year we delay the establishment of a specific metric conversion date, the greater and more expensive we allow the task of metric conversion to become and the greater becomes the cost of conversion.

Our population is increasing each year and much time is wasted in teaching our children a dual system of measurements. The longer we wait, the more people there will be to educate on metric conversion.

The longer we wait to develop a metric conversion plan for industry, the greater the number of opportunities for replacing old machinery with metric machinery which will have been lost.

According to the U.S. metric study, for each year we wait to convert to a full metric system, we lose a potential of $600 million in trade benefits.

Each year new international standards are being established for new products. Our failure to participate actively in those sessions as a metric nation leaves open the possibility of international metric standards being used as artificial trade barriers for American products.

Each year we delay moving toward metric conversion, we also lose potential savings directly within our economy.

Due to the simplicity of computations within the metric system, there has been one estimate that metric time savings in the aerospace industry alone could amount to $65 million a year.

There are many potential savings for the consumer that are lost each year through the use of our present cumbersome customary system.

This distinguished committee is well known for its concern with truth-in-packaging and with advertising laws. Metric conversion should also be considered from the consumer's point of view as a truth-in-packaging bill.

Think of what metric conversion would mean for unit pricing in grocery stores. The decimals of the metric system are directly compatible to our decimal money system. By using cents per kilogram or per millimeter, a consumer will more easily be able to shop comparatively than he is now able to do with the present system of pounds and ounces; pints, quarts, and gallons.

As I see it the arguments weigh heavily in favor of a national plan for metric conversion. To accomplish that end, I have introduced with Senator Inouye, the chairman of the subcommittee on Foreign Commerce and Tourism, a bill. S. 2483, to provide for the conversion of the United States to the international system within a 10-year period.

The provisions of this bill essentially parallel the recommendations of the Secretary of Commerce which were included in the U.S. metric study.

I would only hope that the legislation being put forward by the administration will act as forcefully in this area as does the study itself suggests it should.

Section 3 of my bill provides that the international system of metric measurement shall be the official U.S. system of measurement within 10 years of enactment of my bill.

Title I directs the Secretary of Commerce through the National Bureau of Standards to develop and implement a coordinated national plan of metric conversion.

Title II of the bill provides for a program of metric conversion assistance. It would allow machinery and other equipment purchased for metric conversion to be given, for tax purpose, a useful life of one-half of the usual useful life of the machinery, provided that machinery is purchased within the United States.

Under this bill, too, the Small Business Administration would be authorized to make grants to individuals, such as machinists and automobile mechanics, automobile mechanics have to pay, for example, up to $2,000 for a set of their own tools. These men must purchase new tools because of the metric conversion. Loans would also be authorized for small businesses whose economic viability might be adversely effected by the costs of metric conversion.

The Office of Education in consultation with the Department of Commerce would be authorized by the legislation to undertake a massive program of metric education in the United States.

The bill before you today is a very comprehensive bill. Many of the sections of the bill, such as the taxing provision and small business loans, actually belong in separate bills before other committees which have jurisdiction over those matters. I have only included those provisions in one bill so that the bill would better serve as a vehicle for the discussion of all the issues related to metric conversion.

It would be my hope that the committee would look upon metric conversion legislation as a two-step process. The first step would be the establishment of a metric conversion date and the creation of an agency to develop and implement a plan of metric conversion.

Since the President has announced his support for metric conversion, I see this first step as relatively easy and as one that could be accomplished in this very session of Congress.

The second step would be more complicated and difficult. It would involve all the provisions included in our bill. Some suggest that subsidies should be provided to no one for metric conversion. Others say that small businessmen, automobile mechanics, and the machine tool industry should be provided with financial assistance in the form of tax incentives or direct funds. As can be seen from my bill, I tend to agree with the latter position.

This question of subsidies is closely tied to the nature of the conversion plan that would be created after the Congress passed a law establishing a metrication board.

Consequently, I believe it would make sense for the Congress to delay until the next session any consideration of secondary issues involving subsidies. The true costs of conversion within any period of time will not be seen until Congress has been presented with a schedule for the coordination of metric conversion.

As a matter of fact, the U.S. Metric Study emphasized that many of the costs of conversion can be eliminated by planning and providing for adequate leadtime.

Thus, it would be our hope that we make it our first priority in this Congress to establish the mechanism for planning metric conversion.

We can do this by passing a bill this year with the basic provision that I have outlined.

Since the President supports metric conversion, it would be my hope that we could make a bipartisan effort to pass a bill in this Congress containing those basic provisions.

Business plans its capital requirements years in advance. Much could be accomplished if Congress would simply let the country know that is has made up its mind about metric conversion. The longer we wait to make the basic decision about the metric conversion, the more costly will be the process of metric conversion.

The International metric system is the international language of progress. Our present system, as comfortable as it may be to us, is out of step with the rest of the world and the requirements of science and technology.

While I myself can become nostalgic about maintaining old traditions, I do not believe we can afford to manage a modern industrial economy in today's competitive world with the measurement system of colonial America.

For these reasons, I would urge the committee to move ahead with legislation to bring about metric conversion in the United States.

Somewhat falling in line with the work of this committee is the meeting that takes place tomorrow in the Smithsonian Institution which the Club of Rome and the Woodrow Wilson School are getting together to make a model of the world as it should be in the future.

As they feed into their model the various statistics and facts you find that they have to be fed in in order to make sense on the metric system and not in our system.

I would think that the juxtaposition of these hearings that you have called combined with the session downtown at the Smithsonian tomorrow might bring across to the Nation's press, and the Nation's people the importance of moving in this field. And those press following the things here I hope would see the things that are going on downtown.

Senator Inouye. Thank you very much, Senator Pell.

I would call on Senator Pastore.

Senator Pastore. First of all, I would like to say that my colleague has been the pioneer in this area, a fact for which the country should be very grateful.

I remember not too long ago Edward Teller, the father of the hydrogen bomb and a scientist of international repute, did make the same suggestion to me that the time was ripe when we should convert to the metric system because even American scientists are working with the metric system. They have to convert some of their statistics from the American standard of measurement over to the metric system.

Many of them were trained in that way.

I notice that you suggest here that we set a date certain for the conversion to take place, and one of the curious elements of this problem that has concerned me for some time has been the need for education that has to occur.

I ask you the question, Mr. Pell, insofar as the educational aspect of this problem is concerned, we would have to start that immediately; wouldn't we?

Senator Pell. That is very correct; indeed.

As chairman of the Education Subcommittee, if we could move in this direction with this bill, I would do my best in that subcommittee to try to weave this into the laws.

Senator Pastore. But for a long time the elementary and high school pupil would have to learn it both ways, right?

Senator Pell. Yes, he would have to learn it both ways for about 10 years.

Senator Pastore. So until the end of the conversion period, he would have to speak not only in matters of inches and feet, but also in metric measurements as well.

Senator Pell. He would have to learn in both ways; yes.

Senator Pastore. How much of a burden would this be?

Senator Pell. I think very little. I had the good or misfortune to go to school in England for a year or two and the system is more complicated; they have imperial gallons and so on.

I think the young mind is very capacious, and I think it could absorb this challenge and would enjoy doing it.

Senator Pastore. Converting to the metric system would have a tremendous impact on the advantageous side of our international trade, wouldn't it?

Senator Pell. There would be two reasons for it. From an economic viewpoint, one from the viewpoint of trade. while the opponents would say it would open our market up a bit to imports, it would also mean that we could export in a far more efficient way than we do.

As of now we export less than 4 percent of our GNP abroad. No other technologically advanced nation exports a smaller portion of its GNP than we. We could expand it with this.

One of the reasons why the automobile industry, changed its view on it which adamantly opposed this initially, was that the Ford Motor Co. made a car in England, I think the Anglia, which developed into another Edsel, and part of the problem came from the use of the different measurement. For that reason they broke the line in Detroit and came out with a strong pamphlet advocating going metric.

This meant that the opposition of Michigan, which had been strong before, was far weaker, and that is why we were able to get the study bill through.

Senator **Pastore**. As we go, say, from the conventional system of measurements—inches, feet, and yards, rods, and what have you—would this involve the question of measurements of weight as well?

Senator **Pell**. It would involve weights, but it would not be retroactive. You would not only have football fields of 100 yards but old line titles.

Senator **Pastore**. Would you buy a pound of meat?

Senator **Pell**. You would have to buy a kilo of meat.

Senaotr **Pastore**. A kilo.

Senator **Pell**. Right.

Senator **Pastore**. So you would have to change every scale and educate every butcher.

Senator **Pell**. You would, but since both of us represent a machine tool State, it would be very good for the machine tool industry as the conversion takes place.

Senator **Pastore**. Why is it necessary to give a tax incentive to do this if there are so many advantages?

Senator **Pell**. Because it will be expensive.

Senator **Pastore**. It will be?

Senator **Pell**. Yes, it will be. The costs have not been figured accurately, and they range in a wide spectrum. I think some kind of help is needed for the businessmen and also, as I said earlier, for the individual machinist who has to replace his tools.

Senator **Pastore**. Now, the Senator from Rhode Island has made a very thorough study of this subject. Without the tax incentive, would there be resistance on the part of the business community?

Senator **Pell**. I believe there would be. I think we will go metric but it would take a longer time. When the British went metric a few years ago, they did not have a tax incentive or economic incentive and they had problems going metric, but again, the pressures were far more overwhelming on them to go metric to get into the Common Market, and so forth, that they did it.

But I think if we didn't have this in the bill, it would delay the process another 5 or 10 years.

Senator **Pastore**. To what extent did the Metric Study Commission apprise America's industry of the conversion?

Senator **Pell**. America's industry?

Senator **Pastore**. Yes. Is there, as far as you know, resistance on the part of American industry to this legislation?

Senator **Pell**. In general, in theory, as I said earlier, more than 90 percent of manufacturers favor conversion.

Senator **Pastore**. They do favor it.

Senator PELL. In the long haul. When it comes to doing it, if they have to dig into their pockets and spend the money for it, I imagine that figure would drop. That is why we have this economic feature in there.

Senator PASTORE. That is all I have.

I merely want to say that finally the Senator has reached the day of realization when this mater, that I know has been very, very close to him, is beginning to see the light of day. I congratulate you.

Senator PELL. Thank you.

Senator INOUYE. Thank you very much for your statement, Mr. Pastore.

As the distinguished Senator from Rhode Island is aware, my subcommittee has been conducting hearings on export expansion. In fact, we held nearly 2 weeks of hearings. You have touched upon an important matter close to the heart of the subcommittee.

I would like to just for the record quote a paragraph because I think it deserves emphasis.

According to the U.S. metric study, for each year that we wait to convert to a full metric system, we lose a potential $600 million in trade benefits.

I would also like to add that it may be a potential $600 million loss, but some of these losses can never be recaptured.

Going further here and quoting your statement:

> Each year new international standards are being established for new products. Our failure to participate actively in those systems as a metric nation leaves open the possibility of international metric standards being used as artificial trade barriers for American products.

You have indicated that there is a possibility of these metric standards being used as trade barriers. I would like to add that I am convinced that they are being used at the present time and, we have received testimony to that effect.

As the distinguished Senator is well aware, the first time since 1893 this Nation has suffered a trade deficit, if we had a metric system in operation, we may not have suffered this trade deficit.

So from the standpoint of the effort being made by this committee to stimulate exports, you can be sure that we are in full accord with what you are proposing to us.

Is it your suggestion that we not consider the full measure at this time but just the setting of a date?

Senator PELL. I am sorry, I did not hear you.

Senator INOUYE. You have suggested that this measure be considered in two phases.

Senator PELL. Right.

Senator INOUYE. First the determination of the time.

Senator PELL. Right.

Senator INOUYE. Next year we can get in discussions of how to implement it.

Senator PELL. That is right. First the decision, I think, has to be made and also the time frame set, so that people can make their plans. That we should do now.

Then next year I think we will get more into the mechanics of it as to how we do it, because this was the experience of the other metrication boards as they moved along. You can't block the whole thing out right now.

If you make the decision, though, to move and establish the time frame, when we get a unanimous consent request for a vote, you then know the outside limits and you adjust the legislation and the support needed following that according to the needs.

Senator **Inouye**. After waiting for 180 years, I think 10 years should be more than reasonable.

Senator **Pell**. I would like to read into the record, if I could, just these statistics which are very interesting.

First, there is the ratio of export products to the GNP. As I said earlier, the United States exports 4.4 percent of our GNP.

I know how hard you are working in trying to expand those exports. Canada, for the sake of argument, exports 20.3 percent; France, 12.2 Italy, 14.2; Japan, 9.8; Sweden, 21.5. So we really say from a military viewpoint it is very good to be self-sufficient, but in today's world, we need to expand our trade, which is exactly what you are seeking to do.

Senator **Inouye**. And I believe the statement you have made in response to the senior Senator from Rhode Island as to the attitude of industry. I suspect if subsidies were not made, this conversion might have a bumpy road ahead.

Senator **Pell**. Yes.

Senator **Inouye**. I am convinced from having heard testimony in the past that subsidies would be reasonable, especially for the small businesses. It would be an extremely heavy burden on some of them, say, a short order shop, for example, to acquire costly new tools and measuring equipment.

So I would join you in recommending that the subsidy section be looked upon very seriously.

Senator **Pastore**. One further question, would phase one of this be mandatory or would it be expressed as a sense of the Congress?

Senator **Pell**. Senator Inouye's and my bill it would make it mandatory. I understand there is an administration bill coming up that is less stringent.

My own strong view is it must be mandatory to have that goal that we should reach. As you pointed out in the cloakroom the other day when we reached a unanimous consent agreement. I think it is good to have confined limits, and it is good to have it here.

Senator **Inouye**. Senator Pell is saying that in 10 years the metric system will be the official system.

Senator **Pell**. It will be the only legal system.

Senator **Inouye**. Right now the metric system is a legal system, as a result of which we have chaos and confusion. Some government agencies have already converted into metric systems, NASA for example.

Senator **Pell**. What we lose sight of is that since 1866 it has been a legal system. So it already is a legal system, but it is not being used. This is why we have to make it the legal system.

Senator **Pastore**. But you know the one thing about this; it is always easy to authorize, but it is difficult to fund.

That is the dilemma, of course, not only for the Congress but also for the people who look forward to the legislation and feel secure because it is authorized.

When the appropriations committee gets working on it, of course, then the funding is usually cut below the authorization. That is an understandable story since the people who authorize don't have the responsibility, of course, of coming up with the money.

All phase 1 does is compel that within 10 years or at the end of 10 years we are converting to the metric system. Let us further assume that the Congress next year doesn't come up with the legislation to give these subsidies on the part of the U.S. Treasury. Then here we are; we have commanded something to which we have not given the ability to carry out.

Don't you think the two should be tied together? Don't you think if we separate one from the other we may be jeopardizing the accomplishment of conversion? It would strike me if you said on January 1, 1972, that by January 1, 1982, the only legal system would be the metric system and if in the meantime you haven't provided the incentives which will enable industry to meet that deadline, what you have actually done is to have ordered somebody to do something that he can't afford to do.

Don't you think the two of them ought to be tied together somehow?

Senator PELL. This would be a matter of political judgment. My thought in doing it this way was that it would be more politically acceptable.

Senator PASTORE. That is right, but the point is looking at the pragmatic situation. The committee of the Congress which would authorize this legislation is the Commerce Committee. The tax incentive has to originate before the Ways and Means Committee in the House.

Now I have found that the reason for the trouble around here is that never the twain shall meet. Somehow there has to be an understanding between the Commerce Committee of the House, if they adopt our suggestion, and the Ways and Means Committee of the House that they are going to meet their responsibility together. Otherwise, I think we might find ourselves in a dilemma.

What do you have to say with reference to that?

Senator PELL. I think the normal course of political pressure would handle it, because I think if it were a law, the clamor from the industries that have to convert by a certain date would be such that it would be given priority by the members of the Ways and Means Committee if they found some of their own constituents businesses would go bankrupt without it.

Senator PASTORE. That may be true, but you know what happened to tax sharing. Different people in Congress have different ideas.

Well, I only raise these questions not because I want to in any way play down the importance of this, but I would hope that if the Congress of the United States saw fit to pass this legislation, it would be amenable next year to provide the incentives that are necessary to effect its decision.

Otherwise, I am afraid that we find ourselves in sort of an awkward position. Do you agree with that?

Senator PELL. I completely agree with that. As the position becomes more awkward, the harder the pressures will be to get the money.

Senator PASTORE. Well, I hope so.

Senator PELL. Fine.

Senator PASTORE. Thank you very much.

Senator INOUYE. Once again, I thank you very much, sir, for your leadership in this very important issue.

I assure you that this committee will act upon this measure. It will not simply be heard and filed away.

My compliments to you, sir.

Senator PELL. I thank you very much for that assurance. It means a lot to me. Thank you.

Senator INOUYE. Our next witness is the Honorable Robert McClory, Congressman from the State of Illinois.

Mr. MCCLORY. Thank you very much, Mr. Chairman.

Senator INOUYE. We have to discuss something off the record.

(Discussion off the record.)

Senator INOUYE. We stand in recess until 12:10.

Due to a series of votes coming up, the hearing is recessed until 1:30.

(Recess.)

Senator INOUYE. The committee will come to order.

I would like to once again apologize for the inconvenience to the witnesses, but the Senate decided to some voting this afternoon. We have had five votes in the last hour and a half.

Once again I would like to welcome the very distinguished Member of the U.S. House of Representatives, Congressman Robert McClory from the State of Illinois.

STATEMENT OF HON. ROBERT McCLORY, U.S. REPRESENTATIVE FROM ILLINOIS

Mr. MCCLORY. Thank you very much, Mr. Chairman. I want to say it is a distinct privilege to appear before this committee today on proposals to convert our system of weights and measures to the metric system.

I might say that I had some of my earlier education in a European country. Maybe that is why I developed an interest in the metric system. Furthermore, I happen to come from a district which is the center of the Metric Association, and the president of the Metric Association, Louis F. Sokol, was here earlier in the day.

The Metric Association has stimulated my interest in the subject and has been promoting interest throughout the country for many years.

As an early sponsor of the study program which was authorized in 1968 by Public Law 90-472, I have followed with special interest the work of the U.S. metric study and have examined the reports issued in December 1970, as well as the final report issued in August 1971. The conclusion is inescapable that conversion to the metric system is an idea whose time has come.

Indeed, conversion to the metric system is inevitable. Of course, this a very bad time in our history for us to undertake a comprehensive program of complete conversion to the metric system of weights and measures as the official system of our Nation. However, any later time would be far worse.

Conversion also is desirable. It offers untold advantages to business, to learning, to safety, to international understanding, to advertising, to entertainment, to human comfort, and to efficiency and economy in our social, political, and economic life.

Of course, conversion to the metric system already has been accomplished—partially. The pharmaceutical industry which is predominant in my congressional district employs metric measurements almost exclusively.

This is the case also in the optical, photographic, and many other industries where extensive scientific research and development have taken place. The entire space program is almost entirely metric.

Many industries—particularly those with large foreign sales—employ a dual system, one applying to domestic sales, and the other, applicable to the foreign markets.

Without referring specifically to the provisions of S. 2483 introduced by the distinguished gentleman from Rhode Island, Senator Pell, I would like to make some general remarks indicating my individual views regarding some of the problems which are involved in taking the next and decisive step for converting officially to the metric system and indicating the direction in which I believe our legislative action should move.

But first, let me acknowledge that Senator Pell has provided a vital role of leadership in this area and is entitled to substantial credit for the legislative action which enabled the study program to be undertaken. His further initiative in seeking to implement the study commission's recommendations with a structured conversion program is an essential element in accomplishing the result which he and I both seek to attain.

Let me also commend the chairman of this committee for initiating these hearings. I think some very beneficial results might be attained today by hearing the testimony of the Bureau of Standards and the Department of Commerce on a legislative program calling for conversion to the metric system. This testimony, I understand, will follow mine.

We are particularly fortunate that Great Britain, Australia, New Zealand, Canada, and a few other countries are in the process of converting to the metric system at this very time. We are fortunate, I say, because we can benefit from their experiences and profit from the particular problems which they have encountered.

There seems to me to be several basic principles which should guide us in the development of the legislative program which we should now undertake.

THE PROGRAM OF CONVERSION SHOULD BE ESSENTIALLY VOLUNTARY

In order to carry out a voluntary conversion program sucessfully, it is essential that all segments of our society participate in the action program which must me undertaken.

This should include business organizations such as the U.S. Chamber of Commerce—which, incidentially, is already committed to the support of a metric conversion program—retailers, labor organizations, scientific associations, educational organizations, Federal agencies, State and local units of government, consumer organizations, representatives of the media, including radio, television, and the press and citizens groups.

In order to assure such voluntary cooperation, an officially constituted Metric Coordinating Commission with authority to act and with funds sufficient to perform their essential work should be authorized by appropriate legislation. Such a Commission should be relatively small in number in order to effectively and efficiently peform the basic program of a comprehensive conversion to the metric system.

In addition, a representative advisory commission of virtually every individual industry and economic and social interest should be named.

I might say that in my view, through a cursory examination of the joint resolution delivered today by the Department of Commerce, there are indications that this general objective is being fulfilled.

THE LEGISLATION SHOULD ESTABLISH A TARGET DATE

The measure which I have introduced in the House of Representatives, H.R. 12307, provides for a target date of January 1, 1983. This is roughly 10 years after the effective date of the legislation which I feel should be enacted during this Congress.

This corresponds with the recommendation of the Study Commission as well as the view as expressed by the Honorable Maurice H. Stans, until recently the Secretary of Commerce. I believe this continues to represent the views of that Department.

A 10-year program was adopted by Great Britain in 1965. This is also the time frame adopted by Australia, although Australia did not designate any target date.

It is my understanding that New Zealand is endeavoring to achieve overall conversion within a period of 7 years.

While some areas and some specific activities may require additional time, it would seem vital to a comprehensive conversion program that a fixed time schedule for complete conversion should be established.

AUTHORITY SHOULD BE RETAINED TO EXEMPT SOME ACTIVITIES

International agreements, affecting fasteners, for instance, and various other activities, which do not relate directly to the national economy or to domestic and international commerce, might appropriately be excluded from the comprehensive conversion program.

Certainly screws and bolts and other fasteners, and we have some examples here today, which are currently used in accordance with international measurements should not be required to be converted to metric standards.

Land measurements which continue to apply units which are no longer current should nevertheless continue to be valid although it would seem desirable to standarize these measurements for better understanding and for greater accuracy.

THE CONVERSION PROGRAM SHOULD BE LIMITED INITIALLY TO LENGTH, VOLUME, WEIGHT, SPEED, AND TEMPERATURE

In this connection, measurements of heat, energy, and other subjects which are amendable to measurement according to varying systems should not be included in the 10-year conversion program which the Metric Conversion Coordinating Commisison would establish.

GENERAL PUBLICITY SHOULD ACCOMPANY ACTIONS OF THE METRIC CONVERSION COORDINATING COMMISSION

It is my understanding that resistance in Great Britain has resulted from a seemingly "closed door" decisionmaking policy of the British Metrication Board. It would appear that such resistance could be avoided by keeping the public fully informed of both problems and progress in the conversion program.

A BROAD EDUCATIONAL PROGRAM SHOULD BE ADOPTED AT AN EARLY DATE IN ALL ELEMENTARY AND SECONDARY SCHOOLS

With a target date of January 1, 1983, it is possible to establish an educational program in the public and private schools at the grammar school and high school levels so that usage of the metric system by this large segment of the population would be almost automatic by the time the target date arrives.

Metric measurements are acknowledged to be more logical and timesaving. The existence of such a large segment of our society as those who will have been students during the 10-year period ending in January 1983 would greatly facilitate the changeover which would be effectively completed at the time the target date is reached.

Mr. Chairman, I have confined these remarks to the area of what might be described as "practical considerations." Indeed, this, it seems to me, should be the prime objective of legislation which we may now enact.

Conversion to the metric system should be made convincing and advantageous to all concerned. There should be no suggestion of punishment or attack upon any group or segment of our society. At the same time, we should establish the mechanism for making the program of conversion to the metric system persuasive and logical.

Let me simply add that, according to my information, the estimated costs of conversion have been grossly exaggerated in almost every instance.

In addition, unforeseen benefits such as improved and more economical methods of manufacturing have been revealed in the course of other governmental sponsored programs of conversion to metric standards.

The timeworn objections of inconvenience, expense, dislocation, as well as conscientious criticism of the metric system itself, have effectively delayed up until this time a national program for conversion to metric.

These fears and obstacles should now be discarded, and we should begin, at long last, to move ahead with the rest of the world toward a universally understood and accepted system of weights and measures.

Again, Mr. Chairman, let me express my appreciation for the convening of this committee meeting to hear testimony in support of a national program for conversion to the metric system. I am grateful to have this opportunity to present testimony in behalf of this vital and historic legislation.

Thank you.

Senator INOUYE. Thank you very much, Congressman.

Do you feel that it is possible to have a target date to effect the conversion voluntarily?

Mr. McCLORY. Yes, I think so. I think that industry, including even those industries that are most vitally affected, are reconciled to the conversion and are willing to cooperate to this end.

Furthermore, the fact that the U.S. Chamber of Commerce has endorsed the concept of conversion is very convincing in that direction.

In my district I found that I have the chairman of a committee to convert to the metric system within the wire segment of the steel industry. This gentleman is employed by the United States Steel Co. in Waukegan, and he has talked to me about what they are doing as far as converting to metric measurements is concerned. I believe they have found that it is not nearly as difficult as they had anticipated it would be, and they are working in that segment of the industry to convert voluntarily.

So that I think maybe that is an example of what all the different segments of industry could engage in if they have the proper direction from a national program which would encourage voluntary cooperation from the various segments of our society.

Senator INOUYE. What about the educational aspect of this? Would that be voluntary also?

Mr. McCLORY. Well, I would think it would be voluntary at the local level. But I would hope that the materials for the educational program could be devised nationally and made available to the grammar schools and high schools which I think are the most important aspects of the educational program. I would assume that colleges and graduate schools are capable of educating students by themselves, and we wouldn't need a national program to assist them. Of course, present college students would be beyond the college age by the time the conversion actually occurs.

Senator INOUYE. Should educational subsidies be provided?

Mr. McCLORY. I wouldn't think there would be any need for educational subsidies beyond the cost of preparing and making available the materials.

Senator INOUYE. We have been advised that with subsidies there would be almost unanimous approval of the metric conversion program but without subsidies the opposition would be formidable. Do you agree?

Mr. McCLORY. Well, I would not support the program of subsidies—certainly not at this time. If in the course of the programing it appears there are indications of hardship which I don't think will develop then I think that would be soon enough to consider the possibility of loans or grants to compensate for that. The British program has been entirely voluntary without subsidies as far as I know, and I would hope that in accordance with the metric study that the costs would lie where they fall, that is, try to have them absorbed by industry.

Of course, they will be added to the consumer costs in some cases but I also understand that in the course of conversion of manufacturing processes that tremendous savings are affected at the time that the conversion is taking place so that perhaps the great costs that are anticipated may not prove to be as great as expected.

Senator INOUYE. Who should decide which exemptions to conversion should be allowed?

Mr. McClory. I would think the metric coordinating conversion board, and where there are international agreements in which there is no requirement for conversion that it would just be an arbitrary decision to require that.

As I understand the fasteners business, that is developing rapidly so maybe the thought of exempting them is not valid now. But at the time 3 years ago, or 4 years ago, when we were debating this bill on the floor of the House the question was asked of me in debate as to whether or not the fasteners industry, which was the subject of an international agreement and which was employing at that time primarily inch measurements in contrast to metric, should be exempted. I gave some assurance that at that time it was my feeling that exemption could be accorded.

It seems to me now that the fasteners industry is developing international agreements which are keyed more to metric measurement, so that it might not be necessary to exempt them.

Senator Inouye. I thank you very much, Congressman, for your contribution to this very important measure. I assure you that your suggestions will be seriously considered.

Mr. McClory. Thank you, Mr. Chairman.

Senator Inouye. Our next witness is Assistant Secretary for Science and Technology, the Honorable James H. Wakelin, Jr., accompanied by the Director of the National Bureau of Standards, Dr. L. M. Branscomb.

Welcome to the committee, Mr. Secretary.

STATEMENT OF HON. JAMES H. WAKELIN, JR., ASSISTANT SECRETARY FOR SCIENCE AND TECHNOLOGY, DEPARTMENT OF COMMERCE; ACCOMPANIED BY DR. L. M. BRANSCOMB, DIRECTOR, NATIONAL BUREAU OF STANDARDS; AND ROBERT B. ELLERT, ASSISTANT GENERAL COUNSEL

Mr. Wakelin. Thank you, Mr. Chairman.

I also have with me Mr. Robert Ellert, assistant general counsel of the Department of Commerce.

Senator Inouye. Welcome, sir.

Mr. Wakelin. He works with me and Dr. Branscomb in the area of science and technology.

Mr. Chairman, members of the committee:

I am very appreciative of having the opportunity to give the views of the Department of Commerce on S. 2483, which provides:

> A national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such a system within ten years after the date of enactment of this Act.

Additionally, with the permission of the committee, I would like to submit for the record and to discuss a proposed Joint Resolution: "to establish a national policy relating to conversion to the metric system in the United States," which the Department forwarded to the President of the Senate and Speaker of the House today.

Senator Inouye. Without objection, your joint resolution will be made a part of the record.

Mr. **Wakelin**. Thank you, sir.

On July 29 of last year, Secretary of Commerce Stans submitted to the Congress a report on the 3-year U.S. Metric Study authorized by Public Law 90–472.

In his written message on the State of the Union, the President urged implementation of the study's recommendations as an important step toward restoring the Nation's competitiveness in the international economic area.

Both S. 2483 and the Department's proposed Joint Resolution seek to be responsive to the issues dealt with in the metric study. The study found that many businesses and other economic activities in the United States are already using the metric system, and that such use is increasing—stimulated by the growing worldwide use of metric measurements, and the growing importance of trade and other forms of international interchange.

Many respondents to the various surveys that the study conducted recognize this situation, and see it developing into something close to measurement usage chaos within a few decades unless some national guidance is brought to bear on this matter.

As a consequence, a great majority of businessmen, educators and other informed participants in the study expressed the belief that increased metric use is in the best interests of the United States.

An even larger majority asserted that it would be better for the Nation to increase its metric use by national plan, rather than continuing to drift into mixed customary and metric usage.

Since U.S. professional societies, industry, and other groups are already moving toward metric usage because they believe it is in our own interest and is good for the U.S. economy, it would seem incumbent upon the Federal Government to assist them in this effort by providing a mechanism through which all affected interests in our society can work together to devise and implement a reasoned plan for guiding the Nation through a burdensome period of dual usage of both customary and metric measurement to predominant use of the single measurement system that best meets our needs for the future.

From the trend of the past, we obtain a clear clue as to what that single measurement system will be. One nation after another has adopted the metric system culminating in the last few years with the decision of Great Britain and the other commonwealth countries to abandon their pints and pounds for international metric measures.

Thus the United States is now the only large nation not committed as a matter of government policy to the metric system.

If only one of the two measurement systems is to predominate, it seems evident that the metric system, which now has predominance on a worldwide basis, will be the one.

SCOPE OF THE METRIC STUDY

Before discussing S. 2483, and the Department's proposed joint resolution, I want to review the scope of the U.S. metric study and its general findings.

In the conduct of the study, the primary goal was to give every sector of our society an opportunity to respond to the questions raised by Public Law 90–742.

As one means of furthering widespread participation, the Secretary of Commerce appointed a metric system study advisory panel, comprising almost 50 members from nongovernmental organizations with a wide spectrum of interests and views. The panel was given responsibility to participate in the planning and conduct of the study, and to help insure that opportunity was provided for all sectors of our society to be heard.

The actual investigation and analysis of the questions were carried out through: (1) a series of public hearings, called National Metric Study Conferences, and (2) a number of indepth, supplementary investigations.

Seven hearings, related to various categories of activity and open and announced to the public, were held during the late summer and fall of 1970, occupying 20 days in all.

The U.S. metric study invited oral or written contributions to these conferences from more than 700 groups, including labor unions, trade associations, professional societies, educational associations and consumer-related organizations.

Altogether, some 200 presentations were heard and discussed at the conferences, and almost 100 additional written submissions were received.

Among these 300 organizations who expressed their views to the metric study, the trade associations have over 670,000 firms as members, while the labor unions and professional societies represent some 19,600,000 individual members.

Eleven supplementary studies, each of which was published as an interim report to the U.S. metric study, were used as inputs to the final report. They treated such topics as:

1. A detailed survey of the present situation and views of manufacturing industries;
2. A similar look at the situations in nonmanufacturing businesses;
3. The involvement of the education sector;
4. Commercial weights and measures aspects;
5. Federal agency viewpoints;
6. International trade;
7. Measurement-related international standards problems; and
8. A history of the metric system controversy in the United States.

An additional supplementary investigation assessed and reported the attitudes of the U.S. consumers toward the metric system.

FINDINGS AND CONCLUSIONS OF METRIC STUDY

I have already referred to several of the key findings of the study, but I think it appropriate to summarize all of them at this time.

1. The United States already makes some use of the metric system. Indeed, the U.S. measurement system has been based on international metric standards since 1893 when the meter and kilogram were defined as the official U.S. standards in terms of which our yard and pound have since been defined.

2. Metric use in the United States is increasing.

3. A great majority of businessmen, educators, and other informed participants in the study believe that increased metric use is in the best interest of the United States.

4. An even larger majority believe that it is better for the Nation to increase its metric use by plan rather than by no plan.

5. The costs and benefits of increasing metric use are extremely difficult, if not impossible, to evaluate in dollars and cents.

Accordingly, as explained in the metric study report, estimates of such costs and benefits are highly uncertain. This is as true of Federal agency activities as of other economic sectors.

Although cost estimate figures were obtained and reported in the surveys of industries and of Federal agencies, they are believed to be highly uncertain.

This conclusion is verified by the British experience that such estimates cannot be made even after a product has been converted to the metric system because the metrication costs are hard to identify.

It must be remembered, however, that in any attempt to make such an evaluation, the meaningful comparison is between increased metric use by plan and with no plan, rather than between increased use and no such increased use because the latter course is not available; metric use will undoubtedly continue to increase regardless of what action the Congress takes with respect to metrication.

The meaningful comparison leads to the conclusion that the costs and benefits of increasing metric use by plan would be more favorable than those incurred through continued drift into mixed customary and metric usage.

It is this finding of the metric study that I urge the Congress particularly to bear in mind as it considers the testimony presented to it on metric conversion legislation.

6. In a planned national changeover to metric use, the rule of reason should be followed. Some measurements and dimensions would never need to be changed; the others would be changed only when it would be advantageous to the Nation to do so.

On the basis of these metric study findings and conclusions, Secretary of Commerce Stans submitted the following recommendations in the report of the study:

That the United States change to the international metric system deliberately and carefully.

That this be done through a coordinated national program.

That the Congress assign the responsibility for guiding the change, and anticipating the kinds of special problems described in the report, to a central coordinating body responsive to all sectors of our society.

That within this guiding framework, detailed plans and timetables be worked out by these sectors themselves.

That early priority be given to educating every American schoolchild and the public at large to think in metric terms.

That immediate steps be taken by the Congress to foster U.S. participation in international standards activities—working through recognized private sector standards bodies.

That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs "lie where they fall."

That the Congress, after deciding on a plan for the Nation, establish a target date 10 years ahead, by which time the United States will have become predominantly, though not exclusively, metric.

That there be a firm Government commitment to this goal.

CURRENT U.S. METRIC STATUS

The increase of metric use in the United States results largely from the increase of metric use throughout the world. Every large industrial nation except the United States is now either predominantly metric or committed to become so.

Thus, more and more of the world's manufactured goods are produced in a metric environment and in accord with metric standards.

This worldwide trend results in difficulties for the U.S. manufacturing industry in two ways—

1. As a trade barrier; and
2. As an inconvenience and inefficiency in operations of U.S. plants at home and abroad manufacturing the same products.

It is to mitigate these difficulties that U.S. manufacturers have been increasing their metric use and no doubt will continue to do so.

An important economic advantage to being metric is to facilitate trade to our advantage. The U.S. Metric Study Report on International Trade shows that our exports would be helped more than foreign exports to the United States would be by adopting metric measurements.

The key point is that the supplier must harmonize his measurement practices with the desires of his customers. Many foreign manufacturers already do this for our large, affluent market. But our export market is rapidly becoming exclusively metric.

Clearly, the best way to harmonize measurement practices in the interest of increased world trade is systematically, through compatible international standards.

It must also be noted that standards can be used to erect barriers to trade as well as to lower them. This is happening in Western Europe right now, where members of the European economic community are agreeing on quality standards for certain electrical and other goods.

In operation, this agreement provides that, when products are certified by the producing country as meeting the standards, they will be accepted without further inspection by all the other countries adhering to the agreement.

This mechanism serves to facilitate trade among the agreeing countries, and to inhibit imports from all other countries.

The point here is that to make standards work for you, you have to participate vigorously in their formulation.

Since the International Organization for Standardization and the International Electrotechnical Commission increasingly insist on metric language in their deliberations, our effectiveness is reduced when we fight for inches or pounds, even when we do participate.

If we are going to participate effectively in generating the kind of international standards picture that helps our commerce, we must face the fact that—

1. We don't have a body of U.S. metric national standards to start from, and
2. We certainly wouldn't want to just pick uncritically from European standards and use them.

Consequently, the United States must begin developing the metric standards that are best for us.

There is no time to lose, since the metric study found that a full set of international standards will probably be written in the next 10 years.

If the United States helps write them and begins planning for metric change, it will greatly strengthen U.S. access to world markets. If we neglect these two actions, our competitors will see to it that our reluctance to adopt metric practices will serve as a self-imposed export barrier.

A further advantage of these efforts is pointed up by the British experience that international standardization affords the potential important fringe benefit of reducing excessive varieties and sizes of products, resulting in savings.

A major supplier of tapered roller bearings in the United States has recently demonstrated the potential for such savings, by the introduction of a new simplified line of metric bearings that meet the needs of both domestic and international markets. The possibility of inventory reduction through development of a new standard series of screw thread fasteners is under study by the American National Standards Institute.

This concept arose from the work of a committee of the Industrial Fasteners Institute. Their work illustrates three important principles—

1. Substantial savings may be made in the process of going metric, providing new standards are properly developed;
2. Only the industry, its suppliers and its customers, are close enough to the details to identify these opportunities and—working through voluntary standards bodies—prepare standards that will bring them; and
3. The standards so generated may need to have metric measurement language and some basic internationally compatible dimensions, but it is not likely that the best standards for our use will be found by taking over existing European metric standards wholesale.

WHAT METRICATION IS AND WHAT IT IS NOT

We foresee, if the Congress passes an appropriate metric conversion act, that the country will increase its metric use in a reasoned way, making changes when they can conveniently be made, at minimum or no cost, and not making them when they serve no useful purpose.

Thus, in the manufacturing industry, as products proceed through their evolutionary process of design and redesign, the components that come up for redesign would be designed by using metric measurements rather than our customary measurements. On the other hand, components and products that are not due for redesign would continue to be produced without change; it would not be reasonable or necessary to redesign such items for the sole purpose of making them metric.

For example, the automobile industry informs us that over any 12-year period all of the components in an automobile will have been redesigned. The sensible and most economical way to change the design of the entire automobile to metric is to redesign each component to metric standards when it is scheduled for redesign—preferably to international metric standards, if these are advantageous to the United States. Of course, the automobile industry would want to work closely with the Metric Conversion Board in coordinating its changes with the changes of its suppliers.

A milk packaging machine, however, that perfectly well meets its need and is not scheduled for redesign in the foreseeable future would continue to be produced as it has in the past. When the country's metrication schedule calls for packaging milk in liter rather than quart containers, for example, the milk machine would be modified only to the extent necessary to have it fill liter containers rather than quart containers, which are about 5-percent smaller.

In the case of most widely used items and practices, no change would be made under a metrication program. Our railroad tracks are a prime example—their gage will remain unchanged since their purpose is to fit the wheels of the rolling stock. So will the length of our football fields remain 100 yards just as the lengths of horse races are today measured in furlongs.

In the Middle West, and perhaps elsewhere, the land was surveyed in 1-mile segments, leading to the practice of designating roads as "One Mile Road," "Two Mile Road," et cetera; there would be no occasion to change the names of these roads any more than to drop from the language expressions like, "Give him an inch and he'll take a mile."

Just as manufacturers will base their timetables for change on considerations of equipment life and capital investment, so must the American workingman and workingwoman. We must not lose sight of the fact that many of our workers own their own tools, and for each individual, this set of tools represents a substantial capital investment. Provision for the gradual evolution of the worker's tool inventory to meet future needs must be an important part of the planning for metric change.

The examples above are in the manufacturing industry. Another important area is education. In high schools and colleges metric units are already in almost exclusive use in teaching general science courses, physics, chemistry, and biology. In the elementary grades, however, very little of the metric system is taught. For example, schoolchildren are not expected to know that a meter is somewhat longer than a yard, a liter somewhat larger than a quart, and a kilogram somewhat more than 2 pounds. The teaching of measurements is oriented around the customary system, which makes extensive use of common, nondecimal fractions. This results in much more time and effort being expended by teachers and pupils in the elementary grades in teaching and learning fractions than would be necessary if only the metric system need be taught.

Quite apart from any virtue, teaching metric measures may have as a way to help our children learn useful arithmetic more efficiently, the strongest argument for expanding metric teaching now is to prepare our children for adult life in a metric world.

CHANGING CIRCUMSTANCES THAT WILL INFLUENCE THE METRIC DECISION

During the 3 years of the metric study we observed that circumstances were changing rapidly, making difficult the task of evaluating alternatives for the future. The Governments of Canada and Australia, as well as a number of other countries, made decisions to go metric. Several U.S. industries stepped up their use of the metric measurement.

But the most important changes were events impacting U.S. interests in foreign trade. It became increasingly apparent that our exports to the expanding world market will be disadvantaged unless the United States joins in the effort to develop in this decade a complete body of internationally approved metric standards, seeking the inclusion of the best of U.S. industrial practice.

A recent event dramatizes this very problem.

On February 17, the Parliament of the United Kingdom voted—on a second reading—to enter the European Economic Community, thus moving closer to becoming a part of the largest trade group of nations in the world. One of the means by which EEC has sought to achieve common policy is an agreement on units of measurement. It is clear that in seeking to do business with this Common Market we will experience obstacles if our measurement practices are different.

Quoting from a recent report to Parliament of the Secretary of State for Trade and Industry:

> In October 1971 the Council—of the EEC—ratified a directive on units of measurement. This provides for the exclusive use by January 1, 1978, of a prescribed system of metric units of measurement over a wide area, including the economic field, the field of public health and safety, and administrative activities. This is firmly based on the International System (of units) though it also includes certain additions and other special arrangements, some temporary and some parmanent.

This international system of units (SI) to which the quote refers is the internationally adopted metric system to which I have been referring.

> This directive would apply to the United Kingdom as a members of the EEC. But we have reached agreement with the Community on adaptations to take account of our use of imperial units. It has been agreed that a list of imperial units used in our legislation shall be added to the directive and that decisions should be taken by agreement before 31 August 1976 into which chapters of the Annex to the directive these imperial units should go. Those on which no decision is taken by them will automatically remain authorized for use until 31 December 1979. The Community have also agreed that it will be possible to extend the period of use where special considerations justify it.

Since the United States is not a part of the EEC it is doubtful that we could obtain the same concessions, which, in any event, are clearly intended to be phased out, completely or partially, by 1979.

Resulting directives now being issued by the EEC Council to member countries require the standardization of numerous products and their compliance with the SI system of measurement. Standards for glass, hazardous substances and exhaust devices for motor vehicles have been issued already. Discussion leading to the standardization of can sizes, measuring instruments textiles and agricultural machinery is underway currently in the EEC.

The Committee for the Coordination of European Standards in the Electrical Field (CENEL) agreement among the countries of the

EEC and the European Free Trade Association (EFTA) established standards for electronic components that conform to SI units. These standards impose an additional burden upon U.S. exporters whose products do not comply with metric requirements.

Passage of an Metric Conversion Act would make it easier for our industry and private standards organizations to work with those of all industrial nations to develop international standards in a way so that all countries will share the burden and the advantages of harmonizing measurement practices in the interests of world trade. I am, therefore, pleased to have the opportunity to endorse the passage of legislation toward facilitating the exchange of goods and ideas on an international level.

A change in the customary measurement language of America is not a task that can be performed by the Government for the people. It can only be accomplished by the cooperation of consumers, workers, businessmen and businesswomen, teachers, engineers, and all other sectors of our national life, working together. Such widespread cooperation can be obtained only by means of a well planned, coordinated national metrication program, and I am, therefore, pleased that both S. 2483 and the proposed joint resolution call for such a program.

The proposed joint resolution was drafted by the Department of Commerce to implement Secretary Stans' recommendations. S. 2483 is essentially, but not entirely, consistent with those recommendations.

To simplify my discussion of the details of these two pieces of proposed legislation, I shall discuss the provisions of the proposed joint resolution, and point out where S. 2483 differs importantly from it. The salient features of both the proposed joint resolution and S. 2483 are:

1. They establish, as their main purpose, a national policy of coherent approach to increasing metric use, envisioning eventual metric predominance. The language used to describe this eventual predominance is, however, different in these two bills. S. 2483 would declare it to be the policy of the Federal Government to adopt as the official and standard system of measurement for the United States the international metric system and to provide for converting to the general use of such system within 10 years of the date of enactment of this act. On the other hand, the proposed joint resolution would declare it to be the policy of the United States to make metric units the predominant, although not exclusive, language of measurement with respect to transactions occuring after 10 years of the date of its enactment.

2. Neither S. 2483 or the proposed joint resolution develops a metrication plan, but instead they establish tools to do so.

Senator Inouye. Mr. Secretary, I must call for a short recess. I want to make a short telephone call. Five minutes, please.

(Recess.)

Senator Inouye. May we resume, sir?

Mr. Wakelin. Thank you, sir.

If I may repeat the the second point, neither S. 2843 or the proposed joint resolution develops a metrication plan, but instead they establish tools to do so.

Under the proposed joint legislation a National Metric Conversion Board would be appointed by the President to plan and effect a changeover to the metric system of measurement. In contrast, S. 2483 directs that this changeover be planned by the Secretary of Commerce with appropriate participation of all sectors of the society.

A National Conversion Board, working with the support of the Secretary, is preferable. It would insure such participation by giving representatives from all sectors an actual part in such planning. You may be aware that a like group is guiding the conversion in the United Kingdom. This procedure is working out very well there in achieving the desired objectives. This approach has also been initiated by Australia and Canada in their metrication programs.

The Board would facilitate and encourage the substitution of metric measurement units for customary measurement units with a view to making metric units the predominant language of measurement in the United States after 10 years.

The Board would have no compulsory powers and the changeover would be voluntary. I stress this feature of the proposed joint resolution. Neither the Board nor any Federal agency would be given any additional powers to make changes to metric mandatory.

Weights and measures, which play a most important role in commerce and the marketplace, are regulated by the States. The States coordinate their regulatory power through the National Conference of Weights and Measures. The Board and the National Conference would, of course, cooperate in scheduling conversion of weights and measures but it would be the States that would have the authority to regulate increased use of the metric system. They would no doubt continue to coordinate increased metric use through the National Conference of Weights and Measures as they do now. The Board needs no compulsory powers and would have none.

The Board would be composed of not more than 21 persons appointed by the President. There would also be two members from the House of Representatives and two members from the Senate. None of these members would serve full time. The legislation, however, makes provision for an executive director and a permanent staff. S. 2483 leaves such matters up to the Secretary of Commerce.

Within 12 months after funds have been provided for the Board, it would submit to the Secretary of Commerce for his approval a comprehensive plan to accomplish the changeover to the metric system of measurement. If the Secretary approves such a plan, he would forward it to the President for approval and for transmittal to the Congress for its information.

Upon approval by the President, the Board would begin implementing the plan. In contrast, S. 2483 provides 18 months from the date of its enactment for the Secretary of Commerce to develop a plan. There are two differences:

1. The length of time to develop a plan; and
2. The date on which the planning period begins.

It is clear that the development of the plan would be a complex and time-consuming task. In view of this, the legislation should give the coordinating body a full 12 months as provided in the proposed joint resolution or 18 months as provided in S. 2483 for its planning function from the time it receives its appropriation and is able to commence work, rather than an indefinitely lesser period, foreshortened by the time consumed in the appropriations process.

The Board will cease to exist no later than 10 years after approval by the President of the implementing plan, thereby assuring that a permanent addition to the Federal structure is not established.

The Secretary of Commerce would provide such administrative and staff services as may be requested by the Board.

The Board would submit to the Secretary of Commerce annual reports of its progress. These reports would be forwarded to the President and to the Congress.

The proposed joint resolution implicitly follows the rule that "costs shall lie where they fall" and contains no exceptions, such as accelerated tax writeoffs, or low interest loans as are envisioned in S. 2483. The reason for the omission of these forms of reimbursement in the proposed joint resolution is simple: provision for such reimbursement in this bill would remove incentive during the planning period to develop less costly means of achieving the necessary changes. For example, why should an individual or firm use conversion charts or devices in conjunction with their present equipment if they can obtain new metric measuring equipment subsidized by the Government? Further, such provisions would likely lead to requests from all sectors to have their expenses similarly underwritten by the Government.

Just as industry will make changes to metric usage only as it is economically justifiable for it and the Nation to do so, so will the Federal Government.

In light of this rule, where an agency deems extra funds necessary for metric conversion, the request will have to be justified on the basis of the benefits to be obtained from the specific change envisioned. In short:

1. No commitment has been made by the administration for funding metrication costs of Federal agencies.
2. Any request for Federal conversion funds will be analyzed to assure that benefits will offset the costs, just as we expect industry to do.

This policy is consistent with the "rule of reason" that opposes changes that serve no useful purpose.

In summary, this Department recommends the enactment of the proposed joint resolution. It emphasizes the need for predominance of a single system of measurement without excluding the customary system altogether from our culture. It stresses retention at State level of responsibility for the regulation of weights and measures in retail trade.

Recognizing that the Board must bring together many elements of our society into a framework of voluntary cooperation it places primary initiative on the Board to formulate the conversion plan rather than placing this responsibility on the Secretary of Commerce.

Finally, the proposed joint resolution proposes that costs and benefits should both accrue where they fall. Through this principle, ingenious Americans will find the best ways to minimize the inconvenience, to avoid needless changes and to take maximum advantage of opportunities to introduce moneysaving improvement.

I would emphasize that the decisions faced by the Congress on metric conversion should be viewed in the context of the world scene in the period from 10 to 30 years into the future. A nationally coordinated voluntary metric changeover of this kind will take time to prepare, and even more time to implement.

For 200 years the advantages to America of having an internationally harmonized system of measurements have been discussed in the Congress. I believe the needs of our citizens in the third century of our national life will best be served by enactment of the metric conversion plan set out in the Department's proposed joint resolution.

Thank you, sir.

Senator **Inouye.** Thank you very much, Mr. Secretary.

In your statement you have used the following phrase: "Metric units be the predominant language of measurement in the United States." By that are you suggesting that we will continue to have two legal systems, the customary and the metric system?

Mr. **Wakelin.** Well, our legal standards are those of the international metric system on which our inch and foot and mile are based. We are talking about the common use of measurement units and I would suggest in this common use that metric units should be used for our economic advantage both in trade here and internationally, and in our culture where they seem to be necessary and desirable.

Senator **Inouye.** I think essentially we would be maintaining the status quo, wouldn't we?

Mr. **Wakelin.** Not entirely. I think we are gradually moving now toward the metric system whether we realize it or not. There has been an estimate that, among our manufacturing companies more than 10 percent make some use of the metric system now. The use is growing slowly, and it is predominantly growing in areas connected with international trade.

I would think that football fields, the gauge of railroad tracks, et cetera, are things that don't need to be changed.

Senator **Inouye.** You have suggested—in your last page, I believe—that the incentives should be sufficient to cause industry to begin converting voluntarily.

Mr. **Wakelin.** Yes.

Senator **Inouye.** What would be the incentive for States to begin a massive educational program? I gather from your bill that it is voluntary in that respect and that States would have jurisdiction over the decision to convert or not to convert.

Mr. **Wakelin.** That is correct.

Senator **Inouye.** What would be the incentive there? I am thinking about the third grader or the sixth grader.

Mr. **Wakelin.** Yes, sir, in education, I think the predominant advantage of the metric system for school kids is that it is decimal in character; dividing by 10 is much easier than dividing by four, by eight, by 12, by 5,280, et cetera. I think it adds simplification in the whole educational process, particularly in arithmetic.

Senator **Inouye.** Do you think this would be sufficient incentive to some of these States which are already suffering from a lack of funds? I have no idea what this conversion will cost. Do you have any idea?

Mr. **Wakelin.** Dr. Branscomb, please.

Dr. **Branscomb.** I would like first to supplement Mr. Wakelin's response to your earlier question.

Senator **Inouye.** Yes.

Dr. BRANSCOMB. Concerning the question of what will constitute predominance of the metric language or what restraints will exist on the use of customary language, that involves primarily the question of common practices in retail trade. The States today regulate such practices because the Congress has not seen fit to exercise its authority under the Constitution to establish weights and measures. The States coordinate their efforts through the National Conference of Weights and Measures, and that Conference is very effective in working out uniform and agreed upon weights and measures regulations at the State level.

In many States, but not all, the recommendations of the National Conference are brought into legal effect in the States through an administrative procedure that may include a hearing. The National Conference has studied the metric issue quite closely, and I believe they have expressed their willingness to cooperate with the Federal Government in a program of metric changeover.

So there could be at the end of a 10-year transition period a situation where, by State regulation, the metric units would be required on packages, and weighing machines used in retail trade. For a period of time, perhaps indefinitely, the customary units could appear there also, if the manufacturer wished.

Now, the incentive to get there from here rests, I believe, on a very broad awareness on the part of the informed members of the public—people in many sectors of life—that the changeover is in our long-term interest. Every group that we have talked to in the metric study said they would not expect to achieve an immediate short-term benefit by going metric today. We can only get the benefit for the Nation by doing so as a Nation.

For that reason, I honestly believe that if the Congress will correctly reflect the views of the country and state as a matter of national policy that we should get through the inevitable period of dual usage to a simpler period when we use one system predominantly, we will find that the self-interest is there in the society, including the educational sector.

Senator INOUYE. Is this the British policy?

Dr. BRANSCOMB. Yes, so far as I know, the British have attempted no mandatory regulations that insist that you use this standard or that standard. We and they both depend on the system of voluntary industrial standards.

Senator INOUYE. Do you envision under this national conversion policy that the Federal Departments would require contractors to do Government business according to the metric units?

For example, not too long ago, the Department of Defense attempted to limit the sizes of containers. If the containers were of a different size, no business. Does the proposed resolution envision that these departments would have a massive program requiring metric measurements in all of their purchases, contracts, et cetera?

Mr. WAKELIN. Mr. Chairman, I think——

Senator INOUYE. Let's say you're GSA, and I'm an architect. Would you require me to submit to you plans made out in meters, kilometers, et cetera?

Mr. WAKELIN. I think for anything that is new—a system or major component that is starting completely fresh—this might be in order once we get moving toward the metric system. I think that changing existing parts of items already designed from inches and feet, to centimeters would be fruitless.

I think it is practical to do this in purchasing only for new items.

Senator Inouye. May I call for another recess?

(Recess.)

Senator Inouye. Once again, I apologize, and we will resume our hearings. I believe Dr. Branscomb was going to respond. I wanted to know as to what extent the Executive departments would involve themselves in the metric conversion.

For example, would the GSA require me, as an engineer, to submit all plans in metric units?

Dr. Branscomb. It is a basic principle of the administration's approach that Federal agencies should participate in the development of the plan and in the execution of the plan in the spirit in which all other sectors participate. This means Federal agencies would not be used as a whip or a club to drive the process more rapidly than the society is prepared to carry it out. The Federal agencies should participate through the conversion board, and adapt their own requirements in the marketplace to the timetable that the private sector works out through the conversion board for providing metric components and designs.

GSA presumably would buy metric products, at a time that the manufacturers who have planned to change their production to metric and have reached that phase in the timetable will find a proper market for their product in the Federal Government.

Senator Inouye. My question was, whether contractors would be required to do business with GSA in metric units. Would the plans submitted by an architect have to be drawn in meters and kilometers instead of inches, feet and yards?

Dr. Branscomb. I would think they would set their requirements as they set them now in terms of what constitutes acceptable practice to their suppliers, and what permits efficient operation of the agency.

Senator Inouye. Eventually it will become compulsory?

Dr. Branscomb. Eventually, I suppose the request for proposals and bids would specify the designs and measurement language that has become the predominant measurement language of the country, yes, sir.

Senator Inouye. Mr. Secretary, could you tell this committee why the administration decided on the route of a joint resolution instead of a bill?

Mr. Wakelin. We discussed this at leangth, Mr. Chariman. I think our feeling about it was—and is—that we hope that we will get bipartisan support both in the House and in the Senate. We feel that the joint resolution carries a little more weight in terms of its visibility, and we think the metric system probably deserves this.

Senator Inouye. Although essentially the requirements would be identical to that of the bill?

Mr. Wakelin. Yes, sir.

Senator Inouye. In his State of the Union address, the President stated that we would enhance our competitive position if we moved to implement the metric system of measurement. Do you have any estimate of how much this metric conversion could improve our balance of trade?

Mr. Wakelin. We have made estimates of this, and I would emphasize they are only estimates.

The estimate obtained from the U.S. Metric Study investigation of international trade was that being metric would lead to a net increase of exports over imports of the order of $600 million per year.

Now again, it is an estimate, Mr. Chairman.

Dr. Branscomb. If I may supplement that, it is important to emphasize that the estimate was based on the world as it was two years ago. In conducting the study, we were very deeply impressed by the rate of change of that world situation while we were making the study. I could give you examples of increasing use of the measurement language in the international standards community as a way of making it more difficult for our products to gain international acceptance. If it had been possible for the exporters and importers whom we surveyed in the study to anticipate these changes that are now taking place, then I think they would have estimated a substantially larger amount when they made their projections.

Mr. Wakelin. May I comment on this?

Senator Inouye. Yes, sir.

Mr. Wakelin. I think that we must bear in mind the fact that other countries, such as the U.K., Canada, and Australia, are already involved in such a conversion as we're considering here. That, together with the conjugation of nations into the EEC, which I am sure will draw Britain in closer to the whole metric measurement system, substantiates what Dr. Branscomb points out—that the estimate of $600 million may be too small by a factor of two or three in the very near future.

Senator Inouye. As you have pointed out, Mr. Secretary, at the present time there are so-called invisile trade barriers set up very cleverly by the use of standards.

One could be the standards of measurement. Do you believe that small businesses and those businesses not involved in exports would benefit from a conversion to the metric system?

Mr. Wakelin. Mr. Chairman, I think those small businesses that are concerned as suppliers to the larger industrial corporations, would probably find it to their benefit to do so. If they are suppliers of an item or a system that is not a component of a larger system, they will not be in a hurry to change unless they have their own reasons to change.

Senator Inouye. Under your joint resolution, would you envision grocery stores converting themselves?

Mr. Wakelin. There are an increasing number of items on the grocery store shelves that are beginning to be labeled with both grams and ounces, as you know. I think it is in their interest to do so in terms of standard packaging, and labeling, sir. I would think this may be a slow process. They are starting very slowly right now.

Senator Inouye. Do you have comments, Dr. Branscomb?

Mr. Branscomb. Only to add that the grocery store will change the labeling on the products and the weighing instruments used in the meat department, for example, only in accord with the schedule that the State weights and measures authorities develop as part of a national conversion plan.

So, at some point in time, the grocery store will provide the housewife with products measured and labeled in kilograms, meters, and the like.

Senator INOUYE. Do you believe metric conversion would promote simplification and improvement of products which are redesigned to metric measures, thereby generally stimulating technological improvement?

Mr. WAKELIN. I think that some simplification would result from the decimal basis of the metric system and from a rationalization of sizes of products.

Senator INOUYE. Do you think it would stimulate technological improvement of products?

Mr. WAKELIN. I am not sure I can answer that question definitely. Certainly metric conversion would afford an opportunity for product improvement.

Senator INOUYE. Has the cost of the British conversion to date been below or above initial estimates?

Mr. BRANSCOMB. There were no initial estimates, Mr. Chairman. The British Metrication Board followed with very great interest the Department of Commerce study which was asked by the Congress to attempt such an estimate. They were not surprised that we found difficulties in making a precise estimate. We, in turn, asked the British if they could tell us in retrospect, having changed over to metric standards in many areas of industry, what were the costs involved in that changeover. They were not able to provide us with such data because the responding companies in general found that they were able to absorb these costs in their operating procedures, and they were not able to separate cost associated with metric change from cost of other changes. I don't believe the British Metrication Board had an estimate of the original cost, nor is it able to evaluate today how costly it has been. But it is certainly their opinion, as expressed to us, that the cost has not imposed on their economy a burden that is large, compared to the normal vicissitudes of doing business.

Senator INOUYE. What estimates did you arrive at in your study?

Mr. BRANSCOMB. We made the best attempt we could to determine what the relative costs would be if the use of metric measures in the United States gradually increased in parallel with the customary measures, thus expereincing an extended period of dual usage of both systems, compared with the proposed 10-year changeover after which we would be predominantly metric.

The data we used was obtained from surveys of companies in various industry groups. These companies varied greatly in their prior experience with the issue of metric change. Individual companies that have already had some experience with metric change in general made much, much lower estimates of cost than those who had not had this prior experience. It was difficult, therefore, to aggregate the numbers and extrapolate them to the entire economy.

But on that basis, our best estimate was that the cost of the changeover would be recovered within a period of something like 10 to 25 years after the changeover. We obtained such data from individual companies by asking them, "If you see advantages to your business of going metric, in how many years would you expect to recover the costs of the change?"

Most of the 25 percent of the responding companies that anticipated advantages gave that period 12 to 15 years.

Senator INOUYE. Would you like to mention a number? You haven't given us any number.

Mr. BRANSCOMB. The problem in attempting to provide a meaningful number, Mr. Chairman, is that the added costs of conversion appear during the period in which one is deliberately trying to go through the period of duality. whereas the benefits follow indefinitely afterward.

Senator INOUYE. What would be the estimtae of cost of your program under the joint resolution? Do you have a figure for that?

Mr. BRANSCOMB. Well——

Senator INOUYE. With no subsidy or tax incentives.

Mr. BRANSCOMB. We do not have an estimate of the gross cost because as we have indicated, costs of metric conversion per se, are very difficult if not impossible to evaluate. I can give you an estimate of the change over cost in the manufacturing industry. Mr. Chairman, but as Secretary Wakelin testified, it must necessarily be an estimate that is not reliable. Our metric study survey team reported that cost for the manufacturing industry would be something of the order of $6 billion to $14 billion integrated over the 10-year conversion period from a $300 billion manufacturing industry in a $1,000 billion economy.

Senator INOUYE. Assuming your joint resolution was adopted by the committee, what amount should we be requesting from the Appropriations Committee?

Mr. BRANSCOMB. It is our estimate that the Conversation Board would require approximately $3 million in its first year of operation to carry out its own responsibilities. We are not proposing that any other items be appropriated under the specific label metric conversion, but that the several agencies of Government should pursue their present responsibilities in the light of the changing circumstances in the country, including the metric conversion program.

Senator INOUYE. Would the executive departments require additional appropriations to participate in the conversion program?

Mr. BRANSCOMB. That is unclear until the plan is made. We know, for example, that the highway people will eventually have a problem with changing highway signs, but they change highway signs in any event. The question of whether they would need any extra appropriation would depend on whether or not there is a way that those signs could be changed over 8 or 10 years without additional cost. I believe in most cases if they are put to the test of finding economical ways to participate in the conversion, they will succeed in doing so and may not need substantial extra appropriation.

Senator INOUYE. What was the cost of the metric study?

Mr. BRANSCOMB. Approximately $1.4 million, Mr. Chairman.

Senator INOUYE. NASA has now, I believe, just about completely converted to the metric system. Was this a smooth transition?

Mr. BRANSCOMB. I believe it would be correct to say that NASA has completely incorporated without any difficulty, as far as I know, the use of metric measurement language in all reports and publications. I don't believe NASA has gone completely to the use of metric engineering in their production work.

Senator INOUYE. Would a measure of this sort, whether it be the Pell bill or the administration bill, require our various departments to begin immediately a program of conversion? Or could this be done without legislative authority?

Mr. WAKELIN. I would think it could be done right now, but we wouldn't know what to instruct them to do without a plan in hand.

Senator INOUYE. Would it be possible for the President to delcare as a matter of policy that his departments begin converting immediately?

Mr. WAKELIN. I would think it certainly would be possible. I would hope and expect that that would occur only after a plan had been worked out with respect to how such a conversion were to be implemented.

Senator INOUYE. What do you mean by "predominance"? I just want clarification for the record. You say the metric unit would be the predominant measurement language in the United States. Could you describe what you mean by that?

Mr. WAKELIN. I think Dr. Branscomb can talk to this point.

Mr. BRANSCOMB. I would say that the United States would be predominantly metric, when the goods that are sold in retail trade are identified by weight and volume in metric units, when the common engineering design language of the country is metric just as scientific language is already, and when the general populace has a sufficient facility with metric language, so that the normal discourse of work would in most cases take place through the medium of metric measurements.

We stress the word "predominance" because we believe that there should be freedom of choice in the measurement language that individual citizens use. We expect that the older generation will be uncomfortable for some time with measurement language with which they didn't grow up and there is no reason why there should be a doctrine of expunging from our daily habits all reference to inches and miles and pints and quarts and pounds and other customary units. The criterion cannot be a very precise one because the objective, being an objective of economic efficiency and trade and international disclosure, is adequately facilitated when the basic structure of our economy is in harmony with the world outside with which we wish to interact successfully.

But there is plenty of room for individuals to declare themselves as exceptions and to persist in using the customary measurements.

Senator INOUYE. So one of the basic differences between the administration's resolution and the Pell bill would be that in the Pell bill we would establish the metric system as a national unit of measurement, and it would be the only legal system, with exceptions. In your measure, we will have two systems operating at the same time, with both systems being legal.

Mr. BRANSCOMB. Being legal, Mr. Chairman, for the citizens to use as they please, but not necessarily legal in all commercial transactions. I do believe it will be necessary, if we are to become predominantly metric, for the State weights and measures laws to require that goods in retail trade be marketed in metric units. The gas pumps, for example, would be suitably modified so you buy gas by the liter instead of by the gallon.

Senator **Inouye**. So what you envision in government, through regulations and standards, making it mandatory?

Mr. **Branscomb**. If I may take one exception to your question, Mr. Chairman, yes, I agree that the mandatory feature will arise through the exercise of the existing powers of the States to regulate weights and measures. On the matter of standards, however, I wish to make clear that we believe a great strength of our economy is the flexibility that comes from the voluntary nature of our commercial, engineering standards activities. These standards are voluntary and they should continue to be voluntary. In my view, if the Nation develops a sound set of national metric based standards which are generated in the private sector with full participation by representatives of consumers, suppliers, and manufacturers, and these are designed to improve our economic performance, both domestically and internationally, then they will be used by the very people who have designed them and, therefore, they will gain voluntary acceptance without the necessity of the standards being mandatory.

Senator **Inouye**. You are telling me that at the present time under the current laws on our books, we have sufficient authority to carry out the program set forth in your joint resolution, because it is traditional authority on the part of the government, local and State and Federal, to set up rules regulating sizes, weights, and measurements. This can be done at the present time. The State of Hawaii could, if it wanted to, convert totally to the metric system?

Mr. **Wakelin**. Sure, no problem.

Mr. **Branscomb**. And I might say, the State of Hawaii has one of the best State weights and measures system in the country.

Senator **Inouye**. I thank you very much. That is why I led you to that question.

So, if the conversion can be done without this bill, why would it be necessary to pass it?

I am asking this as a supporter.

Mr. **Wakelin**. I understand.

Senator **Inouye**. We want to strengthen the case here.

Mr. **Wakelin**. I think there are two points in connection with this.

The bill proposes that it should be the policy of the United States to move toward the metric system. I think that statement of policy should be made by the Congress.

I think also that this bill provides a framework for an orderly transition from the present condition until we are predominantly metric. The board would provide participation of the various walks of life, education, labor, manufacturing, in producing an action plan that is visible. It would bring that plan to the attention of the public, and the people who are in the manufacturing and service areas.

I think if one wished to do so, money could be appropriated to a department of the Government to develop such a plan for conversion. But I think you should have in back of this a resolution of the Congress stating it is the policy of the United States to do this.

We look upon this bill as a policy document as well as one setting up the machinery for implementation.

Mr. **Branscomb**. If I may add, Mr. Chairman, there is one feature of the implementation machinery we have not discussed, but which I believe is quite important.

That is that in the process of change to metric, it is quite important to avoid confusion between different parts of industries, suppliers, manufacturers, and distributors. This will require consultation among competing elements in the society.

The preservation of our competitive policy through this period is quite important, and I believe it is not inappropriate that the Federal Government should offer, through the board the framework within which the private sector can assist in the determination of time sequences and plans for changeover.

Senator INOUYE. Is your department and the bureau at this stage prepared to move if and when this measure becomes law?

Mr. WAKELIN. Yes, sir.

Senator INOUYE. And you feel that the 12 months would be sufficient?

Mr. WAKELIN. In my opinion, Mr. Chairman, it is on the borderline. I think the plan is a very difficult one to devise.

I would hope that some consideration might be given to increasing the length of time to develop an adequate plan.

Senator INOUYE. Your bill calls for 12 months, doesn't it?

Mr. WAKELIN. Yes, sir.

Senator INOUYE. I can see a situation in which if you do not meet the time schedule, critics can point and say, "We told you that you were going to fail."

Then, are you suggesting it might be increased to 18 months?

Mr. WAKELIN. I would feel more comfortable if it were.

Senator INOUYE. Are there any other changes to the measure you would like to suggest?

Mr. BRANSCOMB. I think the issue of the time scale is one that deserves full discussion in your hearings. It is difficult to define because there is no precise definition of exactly how complete a plan must be before it is felt to be ready to be submitted to the President.

Senator INOUYE. I asked you because very likely if this measure is adopted, your agency would be providing the basic leadership.

Mr. WAKELIN. Staff support and leadership; Yes.

Mr. BRANSCOMB. We would perhaps provide technical advice and support, but the principle that the board is presidentially appointed and it has its own executive director responsive to the many points of view represented on that board is, we feel, quite critical.

I might also point out that while the plan must be carefully developed and we are concerned about insuring that time is adequate to do a good job, it also must not be regarded as having been set in concrete once it is written.

The plan must be flexible. It must be possible to modify it as time goes by in light of experience and changing international circumstances.

Senator INOUYE. Is the administration adamantly against any subsidy, tax incentive, grant or loan program?

Mr. WAKELIN. The administration doesn't favor it.

Mr. BRANSCOMB. My personal feeling, Mr. Chairman, is that the philosophy of the administration bill with respect to these subsidies, if you like, is consistent with the kind of approach we believe industry should take to the conversion program; namely, that one localize or internalize the cost as much as possible.

One of the reasons that our study is not able to give you an explicit price tag on conversion is because I can't tell you everything that should be changed and not changed in the course of metric conversion. If I could do so, sir, I would presume to be an expert in the business of every businessman and very laborer in this country.

In fact, those decisions need to be worked out in the discourse of the conversion planning progress. Therefore, the costs would be, wherever possible, internalized to the advantage of the various segments of society.

Senator INOUYE. Mr. Secretary, and Dr. Branscomb, I thank you very much.

Mr. WAKELIN. Mr. Chairman, I would like to thank you for your understanding and feeling about this subject. We appreciate your attention to it and we hope you will support it.

Senator INOUYE. I can assure you that this committee will act upon this measure one way or the other. It will not be just filed away.

Mr. WAKELIN. Thank you, sir.

Senator INOUYE. You can be assured of that, sir.

Before calling my final witness, Mr. Frank Winters, I would like to call a 2-minute recess.

(Recess.)

Senator INOUYE. Our final witness this afternoon is Mr. Frank Winters, assistant director of engineering, Caterpillar Tractor Co.

STATEMENT OF FRANK WINTERS, ASSISTANT DIRECTOR OF ENGINEERING, CATERPILLAR TRACTOR CO.

Mr. WINTERS. Thank you.

Would you prefer that I read the full statement or a summary, sir?

Senator INOUYE. A summary would be fine, sir, and without objection, your full statement will be made a part of the record.

Mr. WINTERS. I am Frank Winters, assistant director of engineering, Caterpillar Tractor Co.

If I may, I would like to summarize our statement, and ask that the full statement be inserted in the record.

We felt we might contribute most to your deliberations by describing our own experience with metrication—leaving it largely to you to determine how that experience might be applied in drafting legislation.

Caterpillar is a major manufacturer of earthmoving machinery, diesel engines, lift trucks, and other products. These products are sold throughout most of the world.

Our sales of something over $2 billion a year are about evenly divided between this country and abroad. Two-thirds of our sales outside this country consist of U.S. exports.

We build products in 14 plants in the United States, and 11 plants located in eight foreign countries.

Our plants in France, Belgium, and Japan operate in the metric system of measure. We are now in the process of converting our plants in the United Kingdom to the metric system of measure.

I emphasize the term "metric measure" since we have not adopted metric standards which establish size of things such as fasteners and fittings.

Caterpillar has a basic policy that requires parts and components manufactured anywhere in the world to be interchangeable. In the

United States we design and manufacture using decimal inch units of measure. Plants using metric units of measure convert drawings to metric with the necessary accuracy to achieve full interchangeability.

Recently, in the United States, we have started a program to convert to metric units of measure independently of any action by the United States to go metric.

We will make the change to metric starting with the release of engineering drawings on certain new products.

Our ultimate goal is to achieve total conversion to international metric system measurement units and to international standards for materials which are readily available at each of our plants.

At the outset, we must establish dual capability to use both measurement systems and maintain this dual capability until conversion is completed.

Dual capability requires only that our people understand both measurement systems to the degree their work requires, and having tools in either system they are able to work in that system. This dual capability is achieved through training and practice.

With dual capability, it is possible to design new parts in the metric system, provide metric gaging and tooling as required, and produce these parts on existing machine lines along with existing parts dimensioned in inches.

New designs will be metric, gages and inspection equipment needed for new parts will be metric, and additional machine tools, as needed, will be metric.

It will be necessary to duplicate some general purpose inspection equipment, and some machine tools, but the major amount of equipment conversion will be achieved through normal attrition and replacement.

Similarly, our vast array of active parts numbers will become metric through attrition rather than wholesale conversion.

Until suppliers achieve metric capabilities, we will provide conversion charts on our drawings enabling them to produce to our specifications in the inch system of measure.

Sir, I might refer to the drawing attached to the statement to illustrate the point that we have a conversion chart which in this case is in the upper left-hand corner.

So we are in no way attempting to force any of our suppliers, of which we have some 10,000 in this country, to build these parts in metric system units because in this table we give them the inch equivalent of the metric, so we don't care whether they use metric or inch measure.

But this way it is on the drawing and once total conversion is achieved, we can eliminate that conversion chart.

Senator INOUYE. Has your experience shown that most of your suppliers will convert to metric systems?

Mr. WINTERS. Some are planning to, others are not. We are not asking them to convert because we are converting. We feel this is not our prerogative.

With the passage of time, attrition will create a predominantly metric operation.

Is this kind of a transition practical in the shop?

The answer is yes.

If the dial of a lathe, for example, is graduated in thousandths of an inch, each graduation represents not only one-thousandth of an inch, but also 2½ hundredths of a millimeter.

If gaging a part shows that an adjustment of either .002 inch or .05 mm must be made, the result is the same: two marks on the dial. The simple ratio 2½-to-1, makes such mental conversion quite automatic for an operator who must make such adjustments many times a day.

Linear scales and some dials can be replaced with metric ones at nominal cost, but for the most part, we believe it is better to leave existing equipment as it is, and let training bridge the gap.

The kind of conversion I have described is the least-cost method for Caterpillar. We believe it will be the least-cost method for the country.

In summary, applying our experience to some of the matters the committee must decide in determining the final form of metric legislation:

1. We support the adoption in the United States of metric units of measure known as the international system of units (SI) as outlined in ISO recommendation R1000.

2. We at Caterpillar encourage agreements on common worldwide standards. Many existing standards originating in metric or inch units could become the world standard. However, once the common world measurement system has been agreed upon, new standards of size should normally be selected in modules common to that system.

In this connection, we appreciate this committee's interest in legislation along the lines of the International Voluntary Standards Cooperation Act as a means of strengthening this country's participation in the standard setting process.

I might deviate for just a moment, sir, to suggest that in some of the testimony, I think there is a bit of confusion between changing to metric measure and acceptance of so-called metric standards.

I believe in this country we have far superior engineering standards in our threaded fittings, pipe threads, and all these types of things that have been developed over the years. To abandon these in favor of other standards because they happen to be expressed in metrics is a step backward, in our opinion.

So we support the efforts of the American National Standards Institute, working through the International Standards Organization, to bring about world standards rather than just abandoning our present good standards.

Senator **Inouye**. I agree with you because to do so, we would be forcing an unnecessary disadvantage upon ourselves.

Mr. **Winters**. That is right.

A lot of the so-called conversion costs are related to the confusion over standards; whether we need new mechanic's tools, for example.

The way we are converting, we do not need new mechanic's tools because we are keeping our existing thread standards, bolts and nuts and things like this, until better standards are developed that could be superior.

Senator **Inouye**. You are speaking of just measurement units, aren't you?

Mr. **Winters**. We are converting measurement units; yes, sir.

3. Given reasonable time, machine tool needs for converting to metric can be achieved largely through attrition, substantially reducing the costs to individual companies and to the Nation.

4. Broad participation in planning and carrying out metrication is essential to success. Industry and others affected should have an active role in developing the national plan.

5. In general, we believe conversion costs should lie where they fall, with a minimum of Government subsidy. The approach we have outlined would minimize costs.

Whatever assistance is provided should maintain maximum incentives for economies in converting to metric. Also, those who proceed at an early point in time should not forfeit assistance that might be granted to those proceeding later.

6. Assistance, if granted, should apply to acquisitions of machine tools and equipment regardless of whether it is procured in the United States or from sources in other countries. No purchaser should be required to give up what he considers his best source of supply in order to qualify.

In conclusion, we are pleased to report that we have released a newly designed diesel engine fuel system and major components of a family of newly designed diesel engines for domestic production with metric dimensions.

Other engineering groups are commencing to design in metric units for new products to be released in the future.

Work is proceeding on training programs.

In short, we are following our convictions with action to help achieve a metric America.

Senator **Inouye.** Thank you very much, Mr. Winters.

Am I to conclude from your statement that you would prefer the measure introduced by the administration over the one introduced by Senator Pell?

Mr. **Winters.** We would certainly lean more that way in terms of subsidies. We do not feel that subsidies are necessary and also that it is extremely difficult to determine the cost of conversion.

For example, sir, I mentioned at the end of my comment we are releasing a new diesel engine fuel system. We released this system because it is less expensive than the current one. It would be less expensive, regardless of whether it were designed in inches or millimeters. It makes no difference. The tooling for that particular fuel system is roughly $4 million. We will spend that amount regardless of whether we did it in inches or did it in millimeters. So there is really no conversion cost in that particular case.

I think others are quite similar as we go down this path.

Senator **Inouye.** It has been suggested that under existing law, conversion to the metric system can be accomplished without the passage of any additional legislative authority. You have indicated in your full statement that conversion or adoption of metric measure is inevitable, that this administration-type measure should be adopted. Do you feel a national program is desirable to coordinate all sectors of the economy?

Mr. **Winters.** Yes, sir; we certainly do. It would undoubtedly reduce training costs, because people coming out of school would not have to be retrained in metric measure. Certainly it would have a very beneficial effect on all the 10,000 suppliers that we have, and many segments, I think, would be better coordinated through that route.

Senator **Inouye.** You mention worldwide engineering standards. Do you think the United States would be in a better position to participate in formulation of these standards if we adopt the metric system of measure?

Mr. Winters. Yes, sir; I do not think there is any question about it. We have had representatives from our company serving as representatives of the Society of Automotive Engineers and others in some of the international standards meetings. They come back with reports very definitely that we would have a much stronger position if the United States were going to the metric measure and also, of course, if we had Government recognition of our standards association.

Senator Inouye. By conversion, do you mean that the metric units would be the predominant language of measurement in the United States?

Mr. Winters. Yes, sir.

Senator Inouye. Then you are not speaking of a mandatory full conversion?

Mr. Winters. No, sir; I quite agree with Mr. Wakelin, that there are some units that probably should not be changed. I think only time will tell what some of these may be.

Senator Inouye. You have suggested that this conversion should take effect within a reasonable frame of time. What would you consider to be reasonable?

Mr. Winters. We consider 10 years to be reasonable.

Senator Inouye. When did you begin your conversion program?

Mr. Winters. Our conversion program in this country is very recent. I would say within the last 6 months. On the other hand, we have been converting our designs to metric drawings in Belgium, France, and Japan for nearly 10 years.

Senator Inouye. Are you fully converted now in those countries?

Mr. Winters. The present products that we build in those countries are all built to metric drawings. They are converted by our engineering staffs in those countries.

Senator Inouye. Have you made any dollar estimate as to the benefits in costs that will accrue to your company as you gradually convert your domestic plants to the metric system?

Mr. Winters. We have attempted this. First of all, when the study was being carried on, we were asked to participate in that study and come up with those kinds of figures, and we spent quite a bit of time trying to make a good estimate.

I think that we would not want to quote our estimate today because we are sure that it is higher than we think the actual cost will be. As we have stated during the last 6 months, we have found ready acceptance by our engineering staff, by our shop people, and everyone concerned.

We do not think the training job will be nearly as difficult as we anticipated and this is where most of the cost is applied. As we are starting to make metric parts on the same machine tools that we use for inch parts, we do not see the problem there that requires conversion of instruments and dials and so on. So we are pretty well convinced that our costs will be somewhat less than what we originally estimated.

Senator Inouye. I gather from your statements that you agree with the administration in letting the costs lie where they fall.

Mr. Winters. Yes, sir; that is in our statement.

Senator Inouye. Do you see any area in which subsidies, tax incentives, grants, or loans can be justified to ease conversion burdens?

Mr. WINTERS. I certainly do not feel qualified to answer that question on a broad scale, sir. I would say within our company we do not see the need for subsidies.

Senator INOUYE. At least in the area of manufacturing, you don't see any need or justification for subsidies?

Mr. WINTERS. Again I confine my remarks to my own experience because it is not broad enough to encompass all manufacturing business. On our company in the type of product we manufacture, we do not see the need for it.

Senator INOUYE. I can understand your position as a company that has gone along voluntarily to convert. Having subsidies being made to a competitor who has not followed your lead would give him an unfair advantage and place you in an unfair disadvantage.

Mr. WINTERS. Yes, sir; it could.

Senator INOUYE. I realize one's view should not be imposed on a committee, but I am in favor of converting. I am not saying as to what bill, so therefore I would like to shore up as much as possible arguments to support conversion.

Mr. WINTER. Yes, sir.

Senator INOUYE. Your testimony today has been most helpful. I would like to have your response to some of the criticisms and arguments that may be brought up against conversion.

Mr. WINTERS. We would be happy to respond. I think our experience is a bit unique because we have had experience in conversion in our foreign operations and are now proceeding in that direction domestically. So I think we, having been through it in the United Kingdom and in France, Belgium, and Japan, have a better feeling of just what is involved.

Senator INOUYE. How did the workers take it?

Mr. WINTERS. So far, very well. Frankly, I think our experience indicates that the man in the shop really is not all that concerned about it. If we give him metric measurement tools and say this is the thing you measure and it is so many units, it becomes pretty natural. I might relate to you, sir, a little background that we had some 10 years ago when we decided to stop using fractions of an inch. Of course, most of us were raised with fractions, particularly engineers and shop people are used to talking about the size of something being perhaps a quarter of an inch. We overnight decided to eliminate fractions and use nothing but the decimal portions of the inch, so we put all new drafting scales on our engineering drafting machines, and all drawings going to the shop were made this way, and there was no repercussion at all.

Everybody said that we simplified it. We are getting somewhat the same reaction as we go into the metric system. It is more simple.

Senator INOUYE. Once again I thank you for your assistance this afternoon, and we thank you for your patience.

(The statement follows:)

STATEMENT OF THE CATERPILLAR TRACTOR CO.

Caterpillar Tractor Co. welcomes the opportunity to present this statement in support of legislation to bring about the adoption of the metric system of measure in the United States.

Perhaps we can contribute to the consideration of this legislation by relating our experience in moving toward conversion to metric units of measure in our own operations. We have developed this approach in advance of—but in anticipation of—the adoption of this system on a national basis.

Caterpillar manufactures approximately 60 models of earthmoving machines; a broad line of diesel engines for highway, industrial and marine applications; the Towmotor line of lift trucks; the Inertia Welder, and a number of components for use in the equipment of other manufacturers. These products are sold through independent dealers who operate more than 900 outlets in 120 countries.

Caterpillar Tractor Co.'s consolidated sales in 1971 were $2.2 billion, and more than $1 billion, or 48.6 percent of these sales were to customers outside the United States. Two-thirds of these sales outside this country consist of product exported from our U.S. plants.

Caterpillar operates 14 manufacturing plants in the United States, and 11 plants abroad—three in Great Britain, and others in Belgium, France, Australia, Canada, Brazil, Japan, Mexico and India.

Our plants in France, Belgium and Japan operate in the metric system of measure. We are now in the process of converting our plants in the United Kingdom to the metric system of measure. I emphasize the term "metric measure" since we have not adopted metric standards which establish size of things such as fasteners and fittings.

Caterpillar has a basic policy that requires parts and components manufactured anywhere in the world to be interchangeable. To accomplish this, plants operating in the metric system of measure have converted drawings originating in the domestic operations from U.S. conventional units to metric units with the necessary conversion accuracy to achieve interchangeability.

We have been using this method of operation in metric countries for approximately 10 years. The fact that we have not designed and produced a metric standard oriented product has not noticeably affected our sales.

Caterpillar Tractor Co. supports the conversion to the metric system in the United States with the following qualifications:

1. *We support the adoption of metric units of measure known as the International System of Units (SI) as outlined in ISO Recommendation R1000.* Caterpillar feels the adoption of the metric system of "measure" is inevitable.

2. Based on experience in plants operated in metric measure, Caterpillar Tractor Co. knows that metric units of measure can be adopted without the necessity of adopting metric engineering standards that establish the size of commodities such as fasteners and fittings. These commodities can be and are manufactured and measured in either system of measurement without regard to system of origination. The elimination of a standard on the premise that it is based on inch modules rather than metric cannot be justified.

3. The decision to adopt metric engineering standards covering items such as threaded fasteners, fittings, tubes, pipes, gears, splines, keys and many other commodities must be based on product improvement or long term economic considerations including cost, availability and serviceability.

4. Caterpillar Tractor Co. encourages the agreement on common worldwide standards. Many existing standards originating with design modules in either inch or metric units could become the world standard. However, once a common world measurement system has been agreed upon, *new* standards of size should normally be selected in modules common to that system. In this connection, we appreciate this subcommittee's interest in legislation along the line of the International Voluntary Standards Cooperation Act as a means of strengthening this country's participation in the standard-setting process.

Upon learning that the report to Congress issued in July 1971 by the U.S. Department of Commerce did, in fact, recommend that the United States change to the International Metric System through a coordinated national program established by Congressional action, our Company commenced to plan for a way in which we could introduce use of the metric system into our domestic plants.

It was determined that we should begin to make the change to metric starting with the release of engineering drawings on certain new products.

We plan to proceed at whatever pace is feasible, consistent with our ability to handle the change, and keeping the rate of progress commensurate with the cost.

We believe an orderly, systematic, unhurried transition to metric measurement is preferred to a more quickly-paced transition. Further, because all of our major subsidiaries are already operating or preparing to operate metrically, thus requiring conversion of all engineering drawings and much other data transmitted from or to the United States, there is a very real advantage in having the entire Company use a single measurement system.

To what extent do we propose to metricate, prior to any national program? Two levels of metrication are possible:

The so-called "soft" conversion to metric units of measurement, without changing the actual physical size of the things we presently make and use, is what we are already doing in our plants in France, Belgium and Japan. This conversion we can make throughout our operations, without regard to any action of the U.S. as a whole.

"Hard" conversion, entailing not only a change to metric measurement units but, more importantly, a change to metric standards of size in the materials and components we purchase, cannot feasibly be achieved in the U.S. nor should it be attempted until international standards have been developed and supporting U.S. industries are ready to supply goods to metric standards.

Our ultimate goal is to achieve total conversion to International Metric System measurement units and to international standards for materials which are readily available to each of our many plants. Our immediate plan, until such time as actions by the U.S. Government and/or U.S. industry make total conversion feasible, is to embark in an orderly fashion upon soft conversion, which will give us some immediate benefits in communication with our foreign plants and greatly ease the transition to international standards at some future date.

What is required to effect the change? It is obviously impossible to effect the change overnight. We have already stated that an unhurried change is preferable to a hasty one. The one thing that is absolutely imperative in making the change is to establish dual capability to use both measurement systems at the outset of the program and to maintain this dual capability until the transition is completed. "Dual capability" really means only that our people understand both measurement systems to the degree that their work requires, and that having tools in either system they are able to work in that system. Dual capability is achieved through training and practice.

With dual capability, it is possible to design new parts in the metric system, provide metric gaging and tooling as required, and produce these parts on existing machine lines alongside existing parts dimensioned in inches. This, we believe, will be the least costly way to metricate; and our reason for saying that an unhurried change is best. With dual capability and plenty of time, it will not be necessary to convert existing designs to metric, to replace existing gages with metric, or to recalibrate existing machinery. New designs will be metric, gages and inspection equipment needed for new parts will be metric, and additional machine tools, as needed, will be metric. It will be necessary to duplicate some general purpose inspection equipment, and some few machine tools, but the major amount of equipment conversion will be achieved through normal attrition and replacement. Similarly, our vast array of active part numbers will become metric through attrition rather than wholesale conversion.

Until suppliers achieve metric capabilities, they can produce parts to our specifications using a conversion chart as shown on the drawing appended to this statement.

There are several advantages in this course of action. Keeping present parts in inch means that existing tools and gages need not be replaced but can be used until worn out or until they become obsolete. Releasing new parts in metric means that new tooling, gages and machine tools will be metric. Thus with the passage of time, attrition will create a predominantly metric operation. It may then be desirable to convert the remaining inch drawings to eliminate the inch entirely.

It is important that every practical effort be made, in new design, that scale accuracy dimensions on castings, forgings and all Company produced features (not purchased features such as thread sizes, sheet and plate thicknesses, bar diameters, etc.) be in whole millimetres, or as a second choice, half millimetres. This would not only make our drawings "look" metric, but would effect the greatest possible simplification of scale measurement in the shop. It should also greatly influence the shop people to willingly accept metrication.

What are the practical aspects of all this in the shop? We have stated earlier that our people would be trained in metric measurement so that they would become equally capable to measure in either system. When given a metric print, they would use metric gages; an inch print, inch gages. But they would be required, generally, to produce either part on the same machine tool.

Is this practical? In production, yes. Although nearly all machine tools have calibrated dials or scales in only one measurement system, these dials and scales are rarely used to determine the finished size of the part being produced. They are used principally to make only minor adjustments, after a separate gage or scale has shown the need for that adjustment. If the dial of a lathe, for instance, is graduated in thousandths of an inch, each graduation represents not only one-thousandth of an inch, but also two-and-one-half hundredths of a millimetre. If gaging a part shows that an adjustment of either .002 inches or .05 mm must be made, the result is the same: two marks on the dial. The simple ratio, two-and-one-half to one, makes such mental conversion quite automatic for an operator who must make such adjustments many times each day.

Linear scales and some dials can be replaced with metric ones at nominal cost, but for the most part we believe it is better to leave existing equipment as is and let training bridge the gap.

The most valuable aid to the smooth and orderly transition to the metric system is the willingness of all people, at all levels, to make the transition. With total commitment and total compliance, metrication becomes a matter of applying simple rules to solve simple problems. We must develop training programs to sell the idea to the employees, their families and, ultimately, our communities. We must do nothing to trigger resentment to metrication. Employee attitude, at all levels, is all important.

We see this as the "least cost" method of achieving metrication. We believe it will give us worthwhile benefits in our worldwide operations. It can be done independently of any action of the U.S. to go metric and without adoption of metric fasteners, tolerances, or any present metric standards. The more rapidly we progress in this program, the easier it will be for us to merge into any future national program, and eventually to adopt truly international standards.

In summary, and on the basis of our experience, Caterpillar offers the following recommendations on the final shape of legislation to carry out the recommendation that the United States change to the International Metric System:

1. We support and urge the enactment of legislation to achieve the adoption of metric units of measure known as the International System of Units (SI) as outlined in ISO Recommendation R1000.

2. We oppose any provision requiring adoption of metric engineering standards. International standards should be considered and determined independently of the adoption of metric units of measure.

3. We have initiated a program to adopt metric units of measure on a gradual basis in our U.S. manufacturing operations. Our studies and early experience indicate that an orderly, systematic, unhurried transition to metric measurement will be substantially less costly than a more hurried approach.

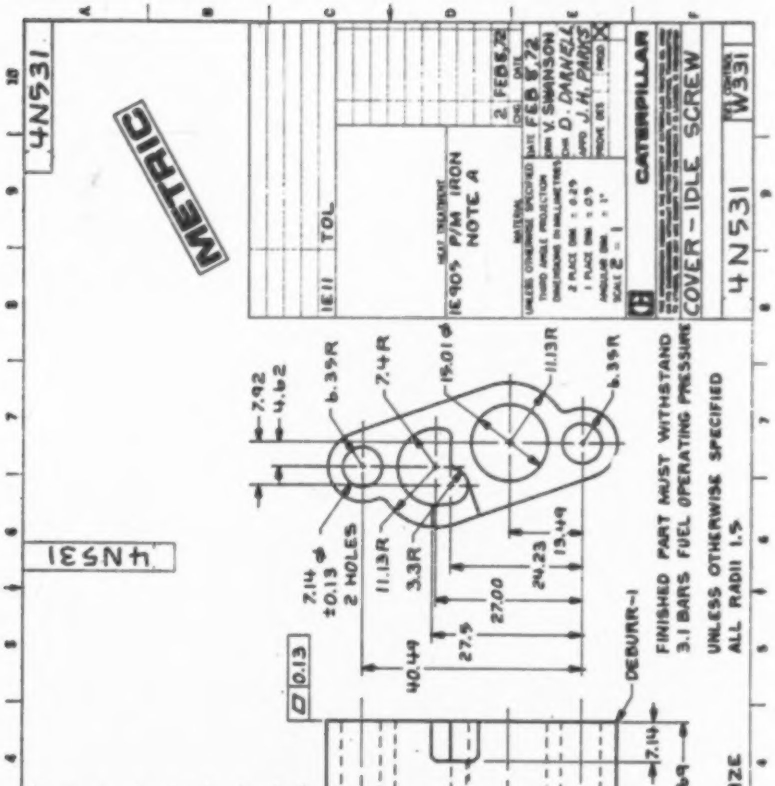
4. Conversion to metric measure requires broad participation by those who must plan and carry it out. Therefore, it is essential that industry, along with others affected, have a strong role in developing the national plan.

5. In general, we believe conversion costs should lie where they fall, without government subsidy. To the extent government underwrites these costs, incentives for achieving economical conversion are reduced. Additionally, it will be difficult to distinguish between machinery and equipment replaced solely because of conversion, and machinery and equipment that would have been replaced in any case because of obsolescence. However, we recognize that Congress may consider it desirable to provide some form of subsidy, such as the accelerated depreciation proposed in S. 2483. Whatever assistance is provided, it should maintain maximum incentives for economies in coverting to metrics. Also, there should be assurance that those who proceed at an early point in time will not thereby forfeit assistance that might be granted to those proceeding later.

6. Assistance, if granted, should apply to acquisitions of machine tools and equipment regardless of their source—whether they are procured in the United States or from sources in other countries. Since the objective is to assist the company that is metricating, those who are compelled—or elect—to purchase equipment abroad should not incur a penalty. No purchaser should be required to give up what he considers his best source of supply in order to qualify.

* * * * * * *

In conclusion, since Caterpillar Tractor Co. adopted its policy to proceed with a gradual conversion to the metric system of measure, we have released a newly designed diesel engine fuel system and major components of a newly designed diesel engine for domestic production with metric dimensions. Other Engineering groups are commencing to design in metric units for items to be released in the future. Work is proceeding on development of training programs for all personnel. Various internal operating procedures are being reviewed to determine what modification might be required to cope with a dual system of measurement. In short, we are following our convictions with action to help achieve a metric America.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Senator **Inouye**. The hearings will resume tomorrow morning at 10 o'clock. Until then, the hearings are recessed.

(Whereupon, at 3:42 p.m., the hearing was adjourned, to reconvene at 10 a.m., Wednesday, March 1, 1972.)

METRIC CONVERSION

WEDNESDAY, MARCH 1, 1972

U.S. SENATE,
COMMITTEE ON COMMERCE,
Washington, D.C.

The committee met at 10 a.m. in room 5110, New Senate Office Building, Hon. Daniel K. Inouye presiding.

Present: Senators Moss, Inouye, and Pearson.

Senator INOUYE. We will resume our hearings on proposals to convert the Nation to the metric system of weights and measures. Since the administration's proposed joint resolution "to establish a national policy relating to conversion to the metric system in the United States" was brought before the committee only yesterday, if any witnesses wish to supplement their testimony at these hearings with a written statement commenting upon this proposal, such views would be welcomed by the committee and made part of the record.

Before proceeding, I would like to insert in the record a statement from the distinguished Senator from Utah, Mr. Moss.

(The statement follows:)

STATEMENT OF HON. FRANK E. MOSS, U.S. SENATOR FROM UTAH

Mr. Chairman, I believe the country should adopt the metric system. Thomas Jefferson led the way on this subject as he did in so many areas. In 1790 he suggested that we adopt the metric system, but the suggestion died in the Senate. Let us take this opportunity to redress that inaction and move our country gently but firmly toward a change-over of our system of measurement.

The United States is now the last hold-out. The Eleventh Geneva Conference on weights and measures in 1960 adopted the metric system as the international standard. With the conversion of Britain, and now Canada, the United States is the last English-speaking country to avoid such a change-over. The metric system is a much simpler method of measurement; we should not preclude our young children from the benefits of that system simply because we memorized a different system.

With the growth of the Common Market, our trade situation may continue to worsen as a result of the different standards used by countries where we wish to compete. Certainly the bulk of our trade deficit cannot be blamed on our system of weights and measures, but in the future it may contribute even more to that deficit, and in all probability it is partially responsible for some of the present deficit.

The United States share of trade with countries using the metric system declined about 18% between 1960 and 1966. Our share of trade with non-metric countries increased 11%. The bulk of the trade market is with the *metric* based countries. This indicates that we are hurting our trading situation by staying with our present systems of weights and measures.

The general atmosphere regarding a transition to the metric system is more favorable than it has been for quite some time. The tide is moving towards the adoption of the metric system. Congress, for the first time, passed a law that could lead us towards this change-over. Public Law 90–472 began the study that has culminated in the report issued by the Secretary of Commerce. This is a time for leadership, and the Senate of the United States and this Committee can and should take such a role.

In the State of Utah, children are supposed to be taught the metric system in school. The Constitution of the State requires this, and with the new interest in the system, the teaching has been expanded to cover grades Kindergarten through 12. This kind of educational process is going to provide substantial assistance in easing the difficulties during such a transition. In fact, the availability and widespread scope of general education in America will allow a much easier transition than has occurred in the past in other countries that have made such a switch.

One of the problems faced by many countries changing to this system in the 19th century was the lack of extensive education in its population.

We have learned how to switch and how *not* to switch. France, in the 19th century, attempted to impose the metric system as a compulsory system during its Reign of Terror. Napoleon decreed the metric system for countries he conquered but, once Napoleon was defeated, and force was removed, those countries chose to abandon the metric system. All of these countries, however, have now returned to the metric system, but have done so on a *voluntary* basis.

If we follow the pattern established by Britain, we will introduce the system slowly through education rather than force. Efforts like the one made in the school system of my state will enable us to move to the advantages of the metric system while encountering fewer disadvantages than almost any other country has faced.

A change to the metric system will be cheaper than most opponents believe. The pharmaceutical industry in this country has already adopted much of the metric system. The costs of the change-over turned to to be roughly one-tenth of those estimated by skeptics. The National Aeronautics and Space Administration has adopted the metric system in some portions of its work, and it does not stand alone as a scientific body to have done so. Most of the medical and scientific organizations in our country prefer a change. The reasons of simplicity, regularity, universality and economic trade benefit all argue for a gentle but steady move to the metric system of measurement.

The U.S. already uses measures such as "seconds" and "amps" in discussing time and electricity. These are both examples of the system used under metric calculation. Congress has clear Constitutional responsibility for the establishment of national standard of measures. We have never officially adopted such a universal standard, although our practice has led to the informal adoption of our present system. Now is the most propitious time in American history for the adoption of the metric system, and I hope my colleagues will seize this opportunity to begin a proper and carefully planned transition.

Senator INOUYE. This morning we will begin our proceedings by hearing from Mr. Roy P. Trowbridge, director of engineering standards, General Motors Corp., for the Automobile Manufacturers Association, Inc.

Welcome to the committee, sir.

STATEMENT OF ROY P. TROWBRIDGE, DIRECTOR, ENGINEERING STANDARDS, GENERAL MOTORS CORP., FOR THE AUTOMOBILE MANUFACTURERS ASSOCIATION, INC.; ACCOMPANIED BY JOHN T. BENEDICT, MANAGER, TECHNICAL INFORMATION, CHRYSLER CORP. ENGINEERING STAFF

Mr. TROWBRIDGE. Thank you, Mr. Chairman.

As you have said, I am Roy P. Trowbridge, director of engineering standards for General Motors engineering staff. I have with me here today Mr. John T. Benedict, who is manager technical information, Chrysler Corp. engineering staff.

Senator INOUYE. Welcome.

Mr. BENEDICT. Thank you.

Mr. TROWBRIDGE. John and I serve on the Automobile Manufacturers Association committee and we are presenting here today the viewpoint of the AMA.

First we should explain that the Automobile Manufacturers Association is the U.S. national trade association of the manufacturers of passenger motor vehicles and trucks in this country. AMA membership includes American Motors Corp., Checker Motors Corp., Chrysler Corp., Diamond Reo Trucks, Inc., Duplex Division with the Warner & Swasey Co., Ford Motor Co., General Motors Corp., International Harvester Co., and White Motor Corp.

We welcome the opportunity to present our views on S. 2483 because of our interest in legislation that would have an impact on the units of measure employed in manufacturing and commerce.

In this statement we propose first to indicate briefly the situation with regard to the use of units of measure in the U.S. motor vehicle manufacturing industry, to comment on specific provisions of S. 2483, and finally to express some AMA member company views on the metric issue.

Now for some background. Within domestic U.S. operations of AMA member companies, the use of metric units of measure is limited almost entirely to some electrical unit expressions and to some research laboratory activities. Some metric unit usage also attends the marketing and servicing of various imported vehicles which are sold in the United States.

Some design work is performed in the United States on vehicles and components for manufacture overseas, in metric areas. Some of these designs have been based on metric modules. Others were based on customary units and subsequently translated to metric. In many instances an automotive firm's international operations in a given country are producing motor vehicles of U.S. origin. This is particularly true in South America. Such vehicles and component designs are based on customary U.S. units. Some use is made of dual dimensioning, and there often is some adjustment of material sizes to accommodate local practices.

Several AMA member companies import automobiles, a number of which have designs based on metric standard practices in their various countries of origin. This has necessitated local warehousing of different noninterchangeable tools and parts. Owner's manuals for such import vehicles typically contain U.S. customary units of measure. These are direct conversions of information, accompanied by language translation, from the original owner's manuals.

In various international operations changes have occurred due to general conversion programs in individual countries. For example, in the United Kingdom motor vehicle manufacturers are now taking part in that country's general, gradual changeover from customary British to metric units.

In France and Germany the local plants of U.S. AMA member companies have, of course, been metric for many years. However, there has been some usage of U.S. designed components, some of which are manufactured in Europe. In those cases metric dimensions are applied, even though the base measurement unit used for design was the inch.

National metric conversion programs in South Africa and Australia will affect the products and operations of AMA member companies in those countries; and as you are aware, both Australia and South Africa have a conversion to metric policy.

U.S. made cars for export are accepted on a performance basis. Measurement units used in the design are not a significant factor in determining the number of vehicles exported. Changes made to these cars are needed mainly to comply with local regulations, rather than to align with the measurement system in the country of use.

Obviously the units used in the manufacture of domestic United States and Canadian cars have no effect on the acceptability of these cars to the buying public here or abroad. Price, comfort and handling, size, styling, availability, overall economy, and many other factors govern the automobile marketplace rather than units of measure.

Following the approach now applied, the use of metric units is determined by need. Hence, at any given future time—if the current voluntary evolution is continued—U.S. motor vehicle manufacturers would be using metric units to whatever extent they were needed because of involvement with international engineering, manufacturing, and sale operations, for some aspect of the export activity, or because of growing use within the United States.

It is possible that in the future worldwide coordinated design programs within multinational operations of individual U.S. based car or truck manufacturers may call for increased collaboration by their engineering and manufacturing groups in the United States with their counterparts in metric areas. In these instances there is a possibility that the decision may be made to express dimensions in metric units or in both metric and inch units. However, the design criteria, engineering standards, and modules might be a mixture of customary unit and metric unit standards. This would depend on economics and various practical considerations at the time of the decision.

Presently, for the purpose of conducting the operations in the United States, most AMA member companies do not have internal needs or justification for initiating companywide metric conversion programs in this country.

The foregoing remarks are intended to provide insight into current measurement unit practice. Now let us turn to the provisions of S. 2483.

I might interject, gentlemen, that if we had had the opportunity to review the administration proposal we would have also commented on it, but we would be glad to volunteer our comments at a later time.

Looking at S. 2483, then, the introduction contained in S. 2483 states that it is—

> A bill to provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to the general use of such system within ten years after the date of enactment of this Act.

We suggest that further thought be given to meaning and implications of language "* * * to make the international metric system the official and standard system of measurement in the United States. * * *" It would not be prudent by such a statement to make it unlawful to use customary units of measure after the country became predominantly metric.

Also, it is our general opinion that legislation "* * * to provide for converting to the general use of such system within 10 years * * *" would be premature at this time.

Of the findings listed, we find a number are correct and are not disputed and I would like to list them.

The first finding, "the United States is the only major nation of the world that is not converting to the international metric system"—true.

The sixth finding, "the language and tools of our scientific community are already using such system"—true. (Although this is not the only system in scientific use.)

Seven, "a common system of measurement would improve international communication"—quite probably.

Nine, "such system is based on fundamental relationships and is easily understood and would be an aid to our educational system"—very true.

Eleven, "new international standards are currently being developed into such system and the United States is not fully participating in such development." True, for another organization (ANSI) I have already testified to that, Senator, as you are aware.

Other findings are the subject of considerable debate and disagreement. Included are:

Number three, "the adoption of such system would enhance our position in world trade markets."

The Metric Study International Trade Report (NBS SP 345–8, p. 3) concluded, "* * * the notion that the United States is losing exports to metric countries because its products are not designed and manufactured in metric units and standards appear to be ill-founded * * *" It goes on to state, "* * * United States exporters and importers rank the measurement factor very low, indicating it affects trade only slightly * * *."

Senator Inouye. Mr. Trowbridge, to facilitate matters, would it be all right to interrupt you to ask questions?

Mr. Trowbridge. Yes, sir.

Senator Inouye. How would you comment on Secretary Wakelin's claim that because of the lack of predominant metric system here we have lost approximately $600 million in trade?

Mr. Trowbridge. I believe the estimate in the report states there is a possibility at some future time of losing $600 million in foreign trade, but this is subject to opinion depending on who reads the data. This $600 million is not firmly founded in fact. It is conjecture.

Senator Inouye. I suppose your assertion is also conjecture too?

Mr. Trowbridge. Our opinion is based on the same facts used to determine the $600 million, and this is an actual quote from the report, Senator.

Senator Inouye. We have been advised by some of your business colleagues, not necessarily in the automobile manufacturing industry, that in the European economic community artificial trade barriers are now being erected which are based upon certain standards, the metric system being one of them.

Mr. Trowbridge. The standards of this country, sir, can be expressed in metric units and find acceptance around the world. They are today. So it is for us to get these standards recognized as international standards as are the ones on the metric base. This is being done.

Senator INOUYE. Would your opinion be the same if the conversion were a voluntary matter?

Mr. TROWBRIDGE. Conversion to metric?

Senator INOUYE. Yes, sir.

Mr. TROWBRIDGE. Yes, sir.

Senator INOUYE. You would be against the voluntary conversion?

Mr. TROWBRIDGE. No. We feel that the legislation aimed at a coordinated conversion is not needed at this time. This is the way we have stated it.

Senator INOUYE. A coordinated effort to bring about voluntary conversion, you would be against that?

Mr. TROWBRIDGE. Yes, sir.

Senator INOUYE. In other words, you want the status quo?

Mr. TROWBRIDGE. We want voluntary conversion at our own pace, yes, sir.

Senator INOUYE. Nothing in the educational system?

Mr. TROWBRIDGE. In the educational system, we note here that we favor that.

Senator INOUYE. Then something has to be done legislatively?

Mr. TROWBRIDGE. Does it? I do not know.

Senator INOUYE. I suppose someone must provide leadership because we have had nearly 200 years of imperial system. I would think that many communities and school systems would be reluctant to convert their educational system to achieve predominance in metric language if no one provides this national leadership.

Mr. TROWBRIDGE. I understand that the NEA has taken a strong resolution in this regard——

Senator INOUYE. In favor of a planned conversion program?

Mr. TROWBRIDGE. Could they not provide that leadership?

Senator INOUYE. We have been waiting for 200 years now.

Please proceed, sir.

Mr. TROWBRIDGE. Right.

Item No. 8, "the Nation is already heading toward such system slowly and haphazardly."

We state it is widely known that United States use of metric units is increasing. It has not been shown that this country will abandon the inch-pound system and convert to metric as the exclusive system.

In real terms, the Nation is becoming bilingual where the need exists.

Finding No. 10, "small businesses and self-employed craftsmen would benefit from a coordinated conversion program."

This has not been proven—and in fact is strongly debated. Many small businessmen and craftsmen are seriously concerned over how they would be affected by a national conversion program. They fear that in effect it would force metric unit usage to increase and accelerate at a rate much more rapidly than would occur through the normal process of evolutionary "freedom of choice."

Some of the findings are unsupported and undocumented by the U.S. metric study data. Included are——

Senator INOUYE. On the matter of freedom of choice, have you had an opportunity to study the administration joint resolution?

Mr. **Trowbridge.** I received it last night, read it through once; I have not had a chance to digest it. In general the terms in the administration proposal, if a bill is to be passed, look much more acceptable than those that appear now in the Pell bill. I am coming to that.

Senator **Inouye.** All right.

Mr. **Trowbridge.** Some of the findings are unsupported and undocumented by the U.S. metric study data. Included are:

Finding No. 2, "the adoption of such system would result in new jobs in the United States."

Finding No. 4, "the benefits of conversion would offset the costs of conversion."

Senator **Inouye.** Wasn't that one of the findings of the metric study?

Mr. **Trowbridge.** This is one of the findings in the Pell bill preamble.

Senator **Inouye.** Well, Secretary Wakelin also asserted that.

Mr. **Trowbridge.** We have studied the same data, and we note that while there is some conjecture that there would be long-term benefits these are not documented in any of the data which we have analyzed. In fact our AMA companies could find no benefits to offset the cost of conversion.

Finding No. 5, "conversion to such system would be a stimulus to the economy and to new investment in plant equipment."

Now addressing section 3 of the bill, as indicated previously, after further review, you may wish to choose wording other than "official and standard" to express the legislative intent. In addition, we are opposed to inclusion of a target date of 10 years for completion of a national metric conversion program. The AMA is not convinced that the need for a legislated, nationally directed metrication program has been shown. We have not seen evidence that the United States would benefit from such a program, with a timetable and arbitrarily fixed end point. Studies by AMA member companies who responded to the U.S. metric study cost questionnaire indicated that under ideal conditions their opinion conversion periods are between 10 and 18 years.

I might point out that these ideal conditions presume you would have an educated public and you would have available parts and materials in metric modular measure and that they would be available at no extra cost. This, of course, was a theoretical study.

If after full consideration of the matter Congress decides that a national conversion program is needed we believe that Congress should carefully study the proposed 10-year schedule and consider leaving the schedule and completion date open until it has been presented with a well thought-out recommendation and supporting documentation for a national plan and an overall program.

Senator **Inouye.** What would convince your organization of a need for conversion?

Mr. **Trowbridge.** I think the best convincer would be an economic advantage—incentive to change.

Senator **Inouye.** I ask this question because I am rather impressed by the fact that when Great Britain, Australia, and New Zealand complete their conversion program the United States would be the only major industrial country insisting upon predominant use of the imperial system of measurement. Why would all these countries decide to convert to the metric system? There must be merit in it; I do not suppose our mother country is made up of dodoes.

Mr. Trowbridge. They have decided to convert as a national policy, and I think I pointed out that an evolutionary conversion may take place as we impinge more on these countries that are converting or have converted. But I think the ballpark in Britain and Australia is different than the ballpark in the United States as regards the percentage of national product which goes into international trade in those countries and in their trading partners.

Senator Inouye. Please proceed, sir.

Mr. Trowbridge. Section 3(b)—this portion of the bill refers to assistance in bearing cost of conversion and to a national education program.

In the opinion of AMA any proposed metric conversion legislation should establish and firmly adhere to the principle that conversion costs are the responsibility of those who incur them. This approach assures that, among the millions of affected people, businesses, et cetera, each would have economic incentive to convert to metric in the most advantageous and efficient manner. A program of Federal subsidy for conversion appears to be workable, as well as prohibitively costly—since metrication would affect the entire Nation.

The AMA is in accord with the bill's reference to educational programs that would familiarize the general public with the metric system and teach it to school children.

Senator Inouye. Mr. Trowbridge, I gather from this that the AMA would agree with the administration's proposal that the costs should be where they fall, but would you also be in favor of providing, say, study grants or special subsidies to school systems to provide special educational programs for conversion?

Mr. Trowbridge. I would think if this were for the purpose of developing curricula and plans for guidance of schools this would be worthwhile. But to say that the Government was going to supply extra moneys to the 40,000, 50,000, or 70,000 school systems in our country would be to allow them to leave out of their budgeting moneys which normally would be used to teach weights and measures to their children and then allow them to come to the Government to ask for moneys just for metrication. I think the metrication should be taught along with other subjects as it is now done. It is not all that difficult as I see it.

Senator Inouye. Please proceed, sir.

Mr. Trowbridge. National Metric Plan, title I. The AMA has the highest regard for the NBS and its able scientific staff. However, since the problems surrounding conversion of the United States to the metric system are largely economic and influence management planning and decisions of many and varied organizations, Congress might wish to consider giving the responsibility for U.S. metric conversion to an independent citizens panel or board, duly appointed and representing all sectors of society, including government.

This board or panel could be supported by appropriate staff activity of one of the administrations departments and certainly the board should be authorized to set up study groups, grants, as you have suggested, or other things which are needed to carry out such a plan.

Appropriations authorized, section 102. The AMA believes that appropriations should be authorized only for funds needed to plan and administer whatever legislated program is to be undertaken, and that moneys should not be provided to pay people or companies just to "go metric."

Metric conversion assistance, title II. Conversion assistance to business and individuals: As indicated above, the AMA opposes this portion of the bill and generally believes that Federal metric conversion subsidies are neither in the best interests of the country nor would they be conductive to economic efficiency in a national metric conversion program.

This is the extent of our remarks directed to specific provisions of S. 2483.

I would like to summarize with a few concluding remarks.

On a subject as complex and far-reaching as this there is not complete unanimity of opinion among AMA member companies on all its details and ramifications. AMA member companies have varying needs and involvements in world affairs. There are fundamental principles, however, upon which there is general agreement and they are summarized here.

The AMA recognizes the increasing importance to the United States of the metric system of measurement and to this end advocates educational effort leading to good use of metric measurement in this country when and where appropriate. To this end, some of our technical societies are hard at work doing it.

At the same time AMA strongly recommends that all parties involved in facing the problems of metric use recognize the importance of the consensus principle of creation and use of voluntary standards, and the inherent advantages of industrial use of chosen engineering standards free from any coordinated plan or legislative direction.

International engineering standards in many areas of common interest are of growing importance to industry in the United States and throughout the world, and to this end AMA strongly endorses increased participation by the United States in international standards making, and active Federal endorsement and support of the American National Standards Institute in this field.

In view of the world measurement system trends, we can well understand the need for Congress to study the situation exhaustively and determine whether or not legislative action is needed.

We feel also that Congress will want to consider carefully the cost of such conversion.

From the booklet here, "A Metric America, a Decision Whose Time Has Come," NBS S-345, reference to benefits and cost begin on page 97. These may be summed up as follows.

The manufacturing industries, estimate, $25 billion; nonmanufacturing business, no estimate, but we can appreciate there will be some; weights and measures, $340 million; Federal civilian agencies, $600 million; Department of Defense, $18 billion; Labor, no estimate given; Education, $1 billion; and there is nothing in there about conversion of cities.

The total that I have here without taking into account the numbers which have been omitted because they were unable to put a handle on them comes to $45 billion.

We appreciate having an opportunity to testify at these hearings, and wish to assure you of our fullest cooperation in providing any further information you may need from AMA or its member companies. We will do our best to comply and help out.

John Benedict is with me to answer any additional questions you may have, Senator.

Senator **Inouye**. My big question is, would you be opposed to the articulation of a national policy to make the metric unit of measure the predominant language of measurement in the United States?

Mr. **Trowbridge**. I must answer that question quite carefully, because let me——

Senator **Inouye**. This is the phraseology used in the administration's measure.

Mr. **Trowbridge**. One of the points I have made on other occasions in this regard is that such a position tends to undermine our bargaining power in international standards activities. Now maybe this point is no longer valid, but the enunciation of such a policy immediately tells the rest of the world these people—the U.S.A.—are paper tigers with their standards. It suggests that we are going to wash our standards down the drain and that we will come up with new metric standards even though such standards do not exist in metal, or in fact, and that world trade will be able to eliminate all inch-based standards.

In this respect I think that the enunciation of such a policy does put us in a bad position in international standards. But from the standpoint of getting from here to there, such a policy might be acceptable if it is properly stated with caution and regard for the actual international engineering standards situation.

Senator **Inouye**. I cannot quite understand that. Are you suggesting that by maintaining our predominantly Imperial system of measurement, with the inch, foot, and yard, that we can get an upper hand in the negotiations or bargaining with these standards organizations?

Mr. **Trowbridge**. No. Let me explain it differently.

Senator **Inouye**. Can be force the Europeans to adopt the inch system?

Mr. **Trowbridge**. May I use an example. Wheels and tires around the world, with a few exceptions, are in-based. The diameter of the wheel and width of the rim, which are very critical measurements in the fit of a tire and its safety and load carrying capacity of the wheel and the rest, are inch-based. If a policy in the United States were enunciated that we plan to go metric, the position of the people that we negotiate with in engineering standards would be, "you are going to change your standards to a metric base, too." This is the attitude. I have been to international standards meetings, Senator, and I know exactly how they react. They say, "Well, since this is not a metric base we will clean it up and rationalize it." This means that the size standard will change, and all the equipment, and technical data will have to change with it.

This is one of the things which I feel would be undermined by such a policy. I did not say that I thought we should continue exclusively with the customary units of measurement.

Senator **Inouye**. As you have indicated, you are presently converting the inch system to the metric system.

Mr. **Trowbridge**. We are required to express all international standards recommendations in metric units.

Senator **Inouye**. What difference would the administration's measure make to your operations?

Mr. **Trowbridge**. Our AMA operations?

Senator **Inouye**. The way I view the administration bill is that it would not affect you at all since it calls for a voluntary conversion. It enunciates a national policy that the metric system should be predominant over a span of time, possibly 10–15 years. It would provide national leadership in teaching our youngsters something about the metric system of measurement.

Mr. **Trowbridge**. Our only question is whether such a policy is needed and could not not be delayed until there was sufficient metric usage to warrant such a policy.

Senator **Inouye**. I quite agree with you there are sufficient laws in our books on the Federal level, the State level, and the local level to bring about conversion, if such be needed, because by law the States can set the units of measure; the State of Hawaii and the State of Michigan, for example, at this moment can constitutionally convert everything into metric units. But in 180 years no one has done this, and we have been advised that it would be in the best interests of the United States if we began converting to a predominantly metric system voluntarily.

But I gather you would be against even the administration's measure?

Mr. **Trowbridge**. I say if legislation needs to be passed, if in the wisdom of Congress it should be passed, we would feel that the proposal of the administration has merit; yes.

Senator **Inouye**. You are not against it?

Mr. **Trowbridge**. I am not against it as such.

Senator **Inouye**. If given a choice between status quo or the administration measure, which would you select?

Mr. **Trowbridge**. I believe our position would be status quo.

Senator **Inouye**. Is that your position, sir?

Mr. **Benedict**. Yes, sir; although I would not characterize it as status quo. I feel the use of metric measurement units is increasing and that rate will accelerate year by year in the immediate future under voluntary response to need.

Senator **Inouye**. Won't it save some money to your organizations in the training programs if high school graduates came into your factories knowing something about metric measurements? I presume you would spend some dollars training them, and you would have to convert their thinking from the inch to the metric measurement. Or does this come automatically?

Mr. **Trowbridge**. This is one of the anticipated costs going metric. You have to convert your entire work force over some period of time to deal with the metric units.

No; as we have indicated, we think there should be dual education. The only question is whether you need heavy legislation in order to accomplish this. I think there are mechanisms already in being that can accomplish this.

Senator **Inouye**. We have gone through the curricula of just about every State in the Union and the official ones all provide for the inch measurement. So I would gather that with the status quo you will have to continue your training program to teach these young men and young women going into your organizations to convert their thinking into the metric system.

Mr. Trowbridge. Well, not everyone has to have such a thoroughgoing knowledge of the metric system as one must have if they are a meteorologist or a physicist. Actually, the units which are needed in the general workingman's life are the meter, the liter, and the kilogram. Beyond that the system becomes much more scientific and this would be handled in the educational institutions.

Senator Inouye. I appreciate your appearance here this morning.

(The following information was subsequently received for the record:)

Automobile Manufacturers Association, Inc.,
Detroit, Mich., March 14, 1972.

Hon. Daniel K. Inouye,
Senate Office Building,
Washington, D.C.

Dear Senator Inouye: The attached comments on "Joint Resolution to establish a national policy relating to conversion to the metric system in the United States" are respectfully submitted in response to your request to Mr. Trowbridge who presented AMA testimony at the March 1 hearing.

Since most U.S. businesses and industries do not, for their own purposes, have justification for full-scale metric conversion programs, we suggest that *if Congress decides Federal action is needed at this time,* such action be taken to "smooth the path" of voluntary evolution—not "force" it unduly.

Also, since AMA verbal testimony (S. 2483 Hearings, March 1, 1972) cited cost estimates from the NBS final report on the U.S. Metric Study, "A Metric America" (NBS SP 345), and later in the Hearings it appeared that there was some misunderstanding of the key timing assumption underlying those national cost estimates, we should like to take the liberty of commenting on that point.

At the Hearing (March 1, 1972), AMA indicated that the NBS estimates for national metric conversion cost totaled "at least $45 billion." It was noted that this figure included: manufacturing industries ($25 billion) . . . weights and measures ($340 million) . . . Federal civilian agencies ($600 million) . . . Department of Defense ($18 billion) . . . education ($1 billion).

The $45 billion figure does not include estimates for such areas as nonmanufacturing businesses.

Later during the Hearings, a reference was made to the $45 billion as the cost of a "sudden, overnight change" to metric.

Because misunderstanding on this point is so prevalent, we wish to note that estimates were made on a "least cost, long duration" basis for complete metric conversion in each area. For example: following the procedure outlined in "Orientation Guide for Company Metric Studies" (as supplied by NBS) the manufacturing industries made their studies on the basis of idealized assumptions that optimized cost (usually over 8–20 year conversion periods.)

Also included in the $45 billion total is the Department of Defense estimate ($18 billion), which is predicated on a 30-year conversion period.

Hence, as documented by the U.S. Metric Study, it is evident that the overall cost estimate is not based on a "sudden, overnight change."

We appreciate having this opportunity to give you our views, and shall be pleased to discuss this with you, or to provide whatever additional information you may require.

Very truly yours,

William F. Sherman,
Director, Engineering Division.

Attachment.

Automobile Manufacturers Association Comments on Joint Resolution:

To Establish a National Policy Relating to Conversion to the Metric System in the United States

INTRODUCTION

The Automobile Manufacturers Association (AMA) is pleased to have an opportunity to comment on the Joint Resolution: To Establish a National Policy Relating to Conversion to the Metric System in the United States.

On March 1, 1972, at hearings on S. 2483 (Metric Conversion Act of 1971) the AMA described current measurement unit practice among its member companies and noted that "... Presently, for the purpose of conducting operations in the U.S., most AMA member companies do not have internal needs or justification for initiating company-wide conversion programs in this country. . . ."

We also questioned the need for a legislated, nationally directed metric conversion program and particularly a ten-year target date for completion of such a program.

We reported that ". . . studies by AMA member companies who responded to the U.S. Metric Study Cost Questionnaire indicated that, under *ideal* conditions, their optimum conversion periods are between 10 and 18 years . . ."

Following the course of voluntary evolution, it is expected that AMA member companies will gradually increase their usage of metric measurement units. It is anticipated that such increase will occur because of: involvement with international engineering, manufacturing, and sales operations; export/import activities; or because of growing metric usage within the United States. Hence, following the approach now applied, the present use of metric units is determined by *need*—and future increase would take place in accordance with need.

We suggest that this basic principle may serve also as a general guide to perceiving a valid goal for the nation as a whole . . . and that the U.S. national policy should be aimed at facilitating the use of metric units—at any future time—to whatever extent they are needed in line with the best social and economic interests in the country.

COMMENTS

Title: We suggest revised wording: "To establish a policy related to increased metric system usage in the United States."

Page 3, item (*1*): The ten-year period recommended by the Metric Study Report and included in the JOINT RESOLUTION [page 3, item (1)] may be insufficient time for the massive nationwide change that is envisioned. Further, we wish to emphasize our opinion that determination of time periods for different sectors of the society should await the Board's recommendation. Some areas may already be largely metric (as testified by the American Pharmaceutical Association) . . . others may be starting self-initiated "soft conversion" to metric units (as stated at S. 2483 hearings by the spokesman for a multinational manufacturer of earthmoving equipment) . . . while others (whose operations are conducted entirely within the United States) may continue indefinitely without needing to adopt metric units.

In any case, if Congress should decide to legislate a national *ten-year* program, we think it is important that the designated ten-year time period should not begin until a suitable plan has been prepared (by the "Board") and approved by the Congress.

Page 3, item (*2*): AMA agrees that encouragement should be given to development of new and revised standards based on metric units. However, we believe this should occur in response to demonstrated need . . . and we suggest that wording of this item (2) in JOINT RESOLUTION be revised accordingly. If standards development is not keyed to need, effort is wasted because the resulting standards are not implemented.

Page 4, item (*5*) (*b*): AMA member companies endorse inclusion of educational programs in the school system, to teach students the metric system to the extent needed at any given time.

Page 5, item (*5*) (*c*): In amending State and local weights and measures laws, we think provision should be made for voluntary use of metric units without excluding the customary inch-pound units.

Page 6, Sec. 3: We suggest that the "Board" be called the "National Metric Board."

Page 7, Sec. 6 (*a*): Twelve months appears to be insufficient time for the Board to "get organized" and complete a planning task of this magnitude. During the S. 2483 hearings, discussion appeared to reflect the opinion that more time is needed. We agree with those who suggest the Board be allotted 20–24 months (after funding) in which to devise a suitable plan for fostering increased use of metric units on a truly voluntary basis.

Page 8, item (*2*) (*c*): We endorse the stipulation that the Board shall have no compulsory powers.

Page 12. Sec. 13: Instead of calling for the Board to be disbanded after ten years, we suggest that the JOINT RESOLUTION should say that, ten years after the Board is established, Congress shall consider the necessity for its continuation and subsequently review the matter at two-year intervals.

DISCUSSION

As stated on March 1, 1972, at S. 2483 hearings: the AMA has some reservations concerning formal statement of metric conversion as a national policy. Despite an earnest attempt to embody the "rule of reason" (make no unnecessary change), such a policy surely would artificially stimulate activity to "go metric". The result could be an accelerated pace of metric unit increase that would not be desirable or economically justified.

Presently, U.S. metric unit usage is increasing on a voluntary basis. As this evolutionary trend progresses, it is facilitated by various developments—such as work underway in U.S. technical societies to acquaint their members with metric measurement units and provide guidelines for their use.

If Congress decides that some Federal action is required, the AMA favors a policy designed to facilitate increased use of metric units where such increase is desirable. The policy should encourage broad education in the metric system. Also, appropriate Boards and panels could assist in coordinating increased metric unit usage—especially where some degree of intra-industry and inter-industry communication and joint planning is necessary.

In regard to timetable for a U.S. "master plan" designed to "smooth the path" of voluntary increase in metric unit usage: we believe it is apparent that, upon thoughtful consideration of the wide scope and many ramifications, the Board should establish the very complex schedule only after extensive investigation, consultation, and fact-finding in the various sectors of the economy.

Recognizing that the question of possible Federal subsidies for metric conversion is among the controversial aspects of this issue, the AMA wishes to express support for the position taken by the JOINT RESOLUTION (page 2) that ". . . maximum efficiency will result and minimum costs to effect the conversion will be incurred if the conversion is carried out in general without Federal subsidies . . ." It is our opinion that this approach, coupled with firm adherence to the concept of *voluntary* metric unit increase, would help to avoid buildup of a costly "bandwagon effect" and assure retention of an incentive to align metric unit usage with genuine need and value.

SUMMARY OF AMA VIEWS

On a subject as complex and far reaching as this, there is not complete unanimity of opinion among AMA member companies on all its details and ramifications. AMA member companies have varying needs and involvements in world affairs. There are fundamental principles, however, upon which there is general agreement and they are summarized here.

The AMA recognizes the increasing importance to the United States of the metric system of measurement and to this end advocates educational effort leading to good use of metric measurement in this country when and where appropriate.

At the same time AMA strongly recommends that all parties involved in facing the problems of metric use recognize the importance of the consensus principle of creation and use of voluntary standards, and the inherent advantages of industrial use of chosen engineering standards free from any coordinated plan or legislative direction.

International engineering standards in many areas of common interest are of growing importance to industry in the United States and throughout the world, and to this end AMA strongly endorses increased participation by the United States in international standards making, and active Federal endorsement and support of the American National Standards Institute in this field.

In view of world measurement system trends, we can well understand the need for Congress to study the situation exhaustively and determine whether or not legislative action is needed.

The AMA and its member companies are pleased to provide the foregoing comments, and we stand ready to explain or supplement this material as may be required.

Senator PEARSON. Mr. Chairman, I am sorry to be late. I have no questions. I did not hear the testimony.

Senator INOUYE. Gentlemen, thank you very much.

Our next witness is Mr. Kenneth Peterson, accompanied by Mr. Mark Roberts.

Gentlemen, welcome.

STATEMENT OF KENNETH PETERSON, LEGISLATIVE REPRESENTATIVE, AMERICAN FEDERATION OF LABOR AND CONGRESS OF INDUSTRIAL ORGANIZATIONS; ACCOMPANIED BY MARKLEY ROBERTS, ECONOMIST

Mr. PETERSON. Thank you, Senator. As you said, my name is Kenneth Peterson. I am a legislative representative for the AFL-CIO, and I am accompanied by Markley Roberts, an economist in the AFL-CIO research department.

In 1969, after Congress enacted the 1968 law authorizing a study of the possible use of the metric system of weights and measures in the United States, the AFL-CIO convention adopted a resolution on the metric system, pointing out that American workers have a high stake in the costs of conversion to a metric system of weights and measures. The 1969 resolution insisted:

> 1. That the present government study of possible conversion to the metric system recognize workers' investments in tools which would become obsolete due to conversion.
> 2. That the extent to which knowledge of the metric system might become an employment prerequisite be examined, in any planning for conversion to the metric system.
> 3. That workers' educational and retraining measures be determined, as part of any change in the system of weights and measures.
> 4. That relief measures, necessary to offset cost to individual workers, be made an integral part of any possible conversion to the metric system.

Last year, Senator Pell introduced his proposed Metric Conversion Act, S. 2483, a bill to provide a national program in order to make the international metric system the official and standard system of measurement in the United States and to provide for converting to general use of such a system within 10 years.

We believe that while such a move might prove to be desirable, the Pell bill is premature because it is the result of a poorly conducted study of the feasibility of conversion. This study, "A Metric America: A Decision Whose Time Has Come," by the National Bureau of Standards in the U.S. Department of Commerce, is the result of the 1968 enactment of Public Law 90-472 which called for an inquiry into both the beneficial and detrimental effects of conversion to the metric system.

The National Bureau of Standards, which handled the inquiry for the Commerce Department, failed to study the economic ramifications of the proposed conversion to workers, industry, consumers, and the American economy in general.

Instead, the study committee, on which labor was vastly underrepresented, concentrated on how conversion could be most easily accomplished.

In addition, the committee report, forwarded to the Congress last August, is notable for what it does not report, as well as for its timetable for conversion.

It does not report, for example, the finding of labor members of the committee that, instead of the widespread enthusiasm for conversion, the committee reports, there is really widespread indifference to such a change.

It does not report on some of the strong objections brought by labor representatives and others to the recommendation that costs incurred by conversion be allowed to lay where they fall.

These costs would include retraining in many fields, purchase of new metric tools and costs to the consumer through changes of quantity in consumer purchases. Such costs would total more than $60 billion.

What is clearly needed then, to overcome the failings of the first study, is a new look at conversion with special emphasis on the cost of such a step to the American worker and his family. Such a study, made by a group representing a true cross section of American society, could be a valuable aid for the Congress in its deliberation over conversion.

It is essential that such a study group have representatives of employers, of workers, of consumers, and all others concerned with the problems and potential benefits of conversion to the metric system.

And it is equally essential that scientists already committed to the use of the metric system, be represented, but only in fair proportion to the rest of society.

Just last month, the AFL-CIO executive council called upon Congress to establish a new conversion study committee, independent of any agency of government, to conduct an inquiry into all phases of the conversion of weights and measures to the metric system.

We urge that such a committee have representation from all segments of American society, including organized labor and that the committee should be allowed to conduct its study and make its report before any action is taken on S. 2483.

Mr. Chairman, I appreciate this opportunity to present the position of the AFL-CIO.

I thank you.

Senator Inouye. Thank you very much, Mr. Peterson. It is always good to see you, sir.

Mr. Peterson. Thank you.

Senator Inouye. Don't you think it would be possible for organized labor to adequately protect its interest by appropriate representation on the metrication board?

Mr. Peterson. We don't know——

Senator Inouye. I am speaking now of the administration measure.

Mr. Peterson. We are not familiar with the administration measure.

Senator Inouye. The administration measure differs from the Pell measure in two basic areas: One, it provides for voluntary conversion. It says that it will be the national policy to make the metric unit of measure the predominant language of measurement in the United States. It speaks vaguely of a time period of roughly 10 years or so. It would be a dual system. It will not be the sole legal system.

In fact, we will have two official systems, the customary system and the metric system.

It also differs with the Pell bill in not providing subsidies, grants, or special loans for conversion costs.

However, the metrication board in its wisdom might provide special funds for retraining programs or for educational purposes. It has been suggested that since there is a gradual phasing out of tools, for example, metric measurements can be adopted slowly. I don't suppose tools last forever, do they?

Mr. PETERSON. No, sir.

Senator INOUYE. They can be replaced as you go along, as the program is being phased in. Wouldn't that gradual phasing out under a voluntary 10-year program meet this objection?

Mr. PETERSON. Well, this is what we don't know, sir. This is why we are asking for more study. We are not sure.

Senator INOUYE. The committee is impressed, as I indicated to the prior witness, that of all the major industrial countries in the world, the United States is the only one insisting upon the system which was based upon the feudal imperial system based on inches and feet. All of the other industrial countries have either converted or are in the process of converting: Great Britain, Australia, and New Zealand. This leaves only the following countries who are still holding on to their own or the imperial system of measurement: Barbados, Gambia, Ghana, Liberia, Muscat and Oman, Sierra Leone, Southern Yemen, Tonga, Trinidad, and the United States.

We are hoping that we might be able to join the rest of the world.

Mr. PETERSON. We could see that possibility, sir, and have said in the testimony here, we believe that while such a move might prove to be desirable, the Pell bill is premature because it is the result of a poorly conducted study of feasibility of conversion.

All we ask, sir, which we think is reasonable, as it affects us so much, and, of course, all of America, is that it be given more study, by a truly representative committee of all segments of American society, industry, labor, farms, the whole broad group.

Senator INOUYE. Don't you believe that labor was properly represented in the last metric study?

Mr. PETERSON. No, sir; we do not.

Senator INOUYE. As you may be aware, the first study on the metric conversion was about 180 years ago, and since that time, we have had several studies. Granted, not all were of major significance, but we have been talking about conversion for many decades now. Your justification for additional study is the conclusion that this conversion may cost $60 billion. How did you arrive at that figure?

Mr. PETERSON. I would be happy to call on Mark Roberts for that.

Mr. ROBERTS. This is based in part on the figures that are presented in the report, the National Bureau of Standards' report, supplemented by our own estimates. It is admittedly a rather foggy figure. The preceding witness suggested a figure of $45 billion, which came from figures in this report, and we have added our estimates to this.

Senator INOUYE. None of us is absolutely certain, but I believe the estimates of $45 and $60 billion are based upon the assumption that the conversion would be sudden; that immediately we would have to change our machine tools, books, highway signs, equipment, etc.

But if it's effected gradually over a period of many years, obsolete tools and equipment would be replaced as they become worn and obsolete. In fact, some of our military equipment is now in the metric measurement.

Mr. Roberts. I believe the report itself suggested about 75 percent of the costs will occur in the first 10 years, so there will be something of a bunching up in the early stages. But you are correctly indicating that the cost will be spread over a period of time.

Senator Inouye. Whether you have a conversion or not, machine tools will have to be replaced, isn't that so?

Mr. Peterson. This is true, sir; but we would hope that any conversion of this sort would indeed be gradual, but we have found—and it follows in history—that once it starts, then there is the movement, instead of this long drawnout gradual thing.

We are remembering the talks of subways in New York. They said it would take a long time to convert to the dime fare. Well, as time passed, they converted overnight and in the Pell bill, there is an 18-month period.

With regard to the volunteer, we find that in these things, in the history of America, when they have been volunteer, they are generally followed by a draft.

Senator Inouye. How do you find——

Mr. Peterson. We want a real study, Senator, before we start into this thing, before we take the necessary steps. We are not opposed to this conversion to the metric system or becoming unified with the rest of the world. We say not a sufficient study has been done as how it will affect us.

We ask that this study be conducted.

Senator Inouye. What is the experience of the working man in the conversion that has already occurred in the United States? We have been advised that many companies are converting on their own because of the economic necessities. Have the workers found this conversion difficult? Are they opposed to it?

Mr. Peterson. Mr. Roberts.

Mr. Roberts. Let me say in the areas where the use of both systems is most prevalent—this is particularly among the machinists—the machinists are able to handle these problems—they are able to handle both systems without any major problems.

Now when I say without any major problems, that doesn't mean there are no problems. There are problems of translating from one system to another. But in general, where people in the machine tool industry are involved, the well-rounded machinist is able to deal in both systems.

Senator Inouye. Have your members opposed this gradual conversion?

Mr. Roberts. We have had members who are reluctant and negative, and we have had some who are indifferent; I don't think there has been any positive reaction. It has been more a matter of indifference and negativism, because there has been some concern about the effect of an excessively hasty change. That is why we ask for further study.

Senator Inouye. I am certain you are much more aware than many of us of the deluge of foreign automobiles on our highways. I would presume that many of our mechanics now would have to retrain themselves to repair a Volkswagen or a Datsun or a Mercedes. Do these mechanics resist this conversion?

Mr. Roberts. I really can't say for certain, because I think this is an area where the machinists union would be more knowledgeable.

I know there are American mechanics who are able to work competently on foreign cars and there are American mechanics using metric system tools. So I think it is not true to say that American workers don't use the system already in some aspects of their work.

Senator Inouye. Thank you very much.

Senator Pearson. Mr. Peterson, if you have no confidence in the report prepared by the National Bureau of Standards, has the AFL–CIO made an in-depth study of conversion to the metric system?

Mr. Roberts. Senator, we have had in 1970 in connection with the study, a meeting of AFL–CIO unions, and in the course of this meeting, we discovered what is referred to in the text here of our prepared statement, the fact that there was no enthusiasm, and in fact, there was a considerable negative feeling.

Senator Pearson. If I may interrupt, there is little enthusiasm for any sort of change. That is a part of human nature, I think. But if labor has not made a study, what did your 1969 resolution rest upon when you made some four itemized objections to the conversion?

Mr. Roberts. We were aware of the law passed in 1968, and we were urging at that time that the study called for by the law include labor participation and provide for full, thorough, and objective studies of the costs to workers and their families, and to consumers, and also——

Senator Pearson. I understand.

Mr. Roberts (continuing). And also to the general public.

Senator Pearson. I understand. I should think this would be of enormous interest to organized labor. We have a vote. We have to go.

I would like to ask, what was the labor representation on the Bureau of Standards committee that you find so vastly underrepresented?

Mr. Roberts. There were three labor members on that committee. One was the research director at that time of the International Association of Machinists, and the research director of the International Brotherhood of Electrical Workers, and the research director of the Oil, Chemical, and Atomic Workers, just three people from the labor movement.

Senator Pearson. Out of a commission of how many?

Senator Inouye. Forty-three.

Senator Pearson. All right.

Senator Inouye. I believe the record will show there were three out of 43, so I can understand your claim that labor wasn't proportionately represented.

Mr. Peterson. No; especially when it comes to us, that the workers are the ones who are affected by it. Thank you.

Senator Inouye. We have a vote, as Senator Pearson indicated. We will recess now and reconvene at 1 p.m.

AFTERNOON SESSION

Senator Inouye. The hearings will resume again.

I hope that we will have at least 20 minutes for the next witness.

Our next witness is Mr. Melvin Green, director of the codes and standards, American Society of Mechanical Engineers.

STATEMENT OF MELVIN GREEN, DIRECTOR, CODES AND STANDARDS, AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Mr. GREEN. Thank you, Mr. Chairman.

Senator INOUYE. Welcome to the committee, sir.

Mr. GREEN. Thank you, Senator.

As you said, my name is Melvin Green, director, codes and standards, American Society of Mechanical Engineers, and I am here to testify on behalf of the society.

We appreciate this opportunity to appear before the committee to testify on S. 2483.

The American Society of Mechanical Engineers is a professional-technical society with a membership of over 60,000 practicing engineers and allied scientists. The society was founded in 1880 and its stated purpose emphasizes the stimulation of technological exchange. This is accomplished through the conventional media of meetings, exhibits, and through the printed page in the form of periodicals, books, and pamphlets.

A society activity of prime importance has been the development of sound engineering standards and safety codes, a notable example of which is the ASME Boiler and Pressure Vessel Code, which is referenced in the safety regulations of more than 70 jurisdictional authorities. These include most of the States of the United States, the major cities in those States which have yet to reference the code, and all of the Provinces of Canada.

A number of Federal agencies include the ASME Boiler and Pressure Vessel Code and the other ASME sponsored safety standards in their respective regulations.

Just to give you an idea of what the Boiler and Pressure Vessel Code is and the volume of it; this is one section of a 12-section code. This section covers nuclear powerplant components. To maintain this one section of the code requires 180 engineers who meet 6 full weeks a year and last year there were working groups of that committee that met during 40 weeks. That was because we were coming out with a revised document using the system approach; the 1971 edition of this code.

Our codes and standards activity is extensive. We have some 5,000 engineers who volunteer and who are devoted to this activity. We have some 500 projects of which this code, the Boiler Code, is one of the 500, and this one-twelfth of the Boiler Code.

Particularly because of this major codes and standards activity and because of its general technological concern, the society has for many years been involved directly in a number of studies dealing with the increased use of metric weights and measures in the United States of America and similar trends toward metric usage in other nations of the world.

In view of the vast involvement of mechanical engineering technology and mechanically oriented industry in measurement, the society believes that it can provide valuable counsel in the development of any national plan for increased use of the metric system. We stand ready to take leadership in the development of the many new and revised national and international standards which will be needed to aid such an increased metric usage in the United States of America and in international trade.

In addition, the American Society of Mechanical Engineers can provide a useful service for the mechanical engineering field and related industry in training and educational programs related to conversion from the United States of America customary units to metric units.

Through its special committee on metric study, the society has taken note of the United States Metric Study report, which was submitted to Congress by Maurice H. Stans, Secretary of Commerce, during July 1971 and has studied S. 2483, submitted by Senator Pell for the purpose of implementing the recommendations of the United States Metric Study report.

I may add that our special committee on metric study had representatives from all of the 11 regions of the American Society of Mechanical Engineers, which covers Canada, the United States, and parts of Mexico. We had input from all these regions because the officers from these regions who were members of the study committee went to the regions trying to get input as to the direction we should recommend to our council and in turn to this committee.

As a result of this study, the society would like to introduce the following comment:

(1) It does not appear to be desirable to provide a financial incentive through Federal subsidies and tax writeoffs in order to spur conversion to metric. It is the opinion of the society that such financial offers will add substantially to the national cost of conversion and will be extremely difficult to administer equitably.

It is believed that moneys appropriated should only be those amounts necessary for coordination, developing of programs and communications with the various segments of the economy. If during the conversion period hardships are experienced by certain segments of the economy, these hardships can be alleviated through other assistance programs or through subsequent legislation having direct bearing on the question.

(2) It is believed that an independent commission, appointed by the President, should be responsible for developing and directing the conversion plan, and that this commission preferably not be designated as a part of any of the administrative branches, although one of the administrative branches of Government might provide necessary services. The commission should be composed of representatives from the general public, government, industry, commerce, education, the professions, et cetera. It should be authorized to establish special advisory committees in any of the many disciplines which will require special attention.

(3) The number of years set as a target date for conversion to metric should not be stipulated in the metric bill; rather the time period for conversion should be left for development by the commission. Such a time period may well be a series of time periods for various sectors of industry, commerce, and the general public, which can be best determined after appropriate study by the commission and advisory committees. The time periods would, of course, be reported to Congress and the Nation in progress reports of the commission.

In conclusion, I would like to reiterate the American Society of Mechanical Engineers' willingness to participate in the development of plans for increased metric use on the part of mechanical engineering oriented industry in assisting in the necessary educational and training programs, and developemnt or revision of the many engineering standards which will be required for a number of years to come during such increased metric usage.

Thank you very much for the opportunity to appear before the committee. I will be glad to entertain any questions.

Senator Inouye. Mr. Green, I thank you very much for your testimony this afternoon. I gather from your statement that your society would favor the measure prepared by the administration which will be introduced shortly.

Mr. Green. Unfortunately, the society has not had an opportunity to study that.

Senator Inouye. We are aware of that. It will be officially introduced sometime soon. It is essentially what you have been advocating. It does not make the international system the sole legal system of the United States. We will still have the dual system, but it would be a national policy that the metric unit of measurement will be the predominant language of measurement in the United States within 10 years.

There would be no subsidies or grants or loans. We would have a special commission appointed by the President with representation from all segments of society which would develop plans after 12 months of hearings and studies.

I think essentially, if I read your statement correctly, you are favoring the administration measure.

I would hope for the record, if you will, study the measure which will be submitted soon and favor us with your comments.

Mr. Green. We would be glad to do that.

Senator Inouye. Unfortunately, when we called these hearings we just had one bill before us. I think you are leaning toward the administration bill.

Mr. Green. Well, we will study the administration proposal and we will submit our comments.

(The following information was subsequently received for the record:)

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS,
New York, N.Y., March 14, 1972.

Senator Warren Magnuson,
Senate Office Building,
Washington, D.C.

Dear Senator Magnuson: At the conclusion of Mr. Melvin R. Green's testimony on March 1, 1972 before the Committee on Commerce, U.S. Senate on the Proposal to convert to a Metric System of Weights and Measures (S. 2483), Senator Inouye requested that the Society study the Joint Resolution and present its views regarding the Joint Resolution.

After such study, The American Society of Mechanical Engineers feels that the Administration Proposal is fundamentally in accord with the testimony of the Society with respect to the Pell Bill, S. 2483.

We would like to suggest, as we did at the hearing, that any legislation relating to the conversion to the metric system in the United States not stipulate a time for completion; rather, the Metric Board should be requested to develop the timetable for various sections of the economy during development of the conversion plan.

The ASME is of the opinion that the one year period proposed for development of a conversion plan is too short; at least six months will be required to select and accredit the suggested Board; then, the Board will need to appoint investigative task groups to consult with the many sectors of industry, commerce, government and the general public. The reports of these task groups will need to be integrated to develop a feasible plan; additional consultation may be required before the final plan is completed; therefore, it appears that two (2) years to develop a plan would be more realistic.

The ASME also believes that the ten (10) year period contained in the Joint Resolution may be too short a time to reach the objective to bring about predominate metric usage; this period could cause undue pressure on certain segments of the economy. It is our feeling that the bill should not provide for automatic discharge of the Board after ten (10) years but should provide for a review of the need for the Board by Congress at that time with stipulation of limited extension period.

As we indicated in our testimony, and in our letter to you of January 18, 1972, the Society, in view of the vast involvement of mechanical engineering technology and mechanically oriented industry in measurement, believes that it can provide valuable counsel in the development of any national plan for increased use of the Metric System (SI). We stand ready to take leadership in the development of the many new and revised national and international standards which will be needed to aid such an increased metric usage in the United States of American and in international trade. In addition, ASME can provide a useful service for the mechanical engineering field and related industry in training and educational programs relating to conversion from the United States of America Customary units to Metric (SI) units.

In conclusion, we repeat our offer to testify before your Committee or one of its subcommittees on this subject. In order for us to make the necessary preparation, we would appreciate advance notice of the scheduled dates of such hearings.

We again express our appreciation for the opportunity that we had to testify on March 1, 1972.

Sincerely yours,

KENNETH A. ROE.

Senator INOUYE. Thank you very much, sir.

Our next witness is Mr. Frank Masterson, president of the Industrial Fasteners Institute.

I have been advised that Mr. Masterson has to catch a flight.

STATEMENT OF FRANK MASTERSON, PRESIDENT, INDUSTRIAL FASTENERS INSTITUTE; ACCOMPANIED BY FRANK AKSTENS

Mr. MASTERSON. Thank you, sir. I thank you for your courtesy, Mr. Chairman. With me is Frank Akstens, who is with us on our professional staff.

Senator INOUYE. Welcome.

Mr. AKSTENS. Thank you, Mr. Chairman.

Mr. MASTERSON. I am Frank Masterson, president of Industrial Fasteners Institute, which is an association of manufacturers of products in SIC 3452: nuts, bolts, screws, rivets, and special engineered assembly components which are vital to the safe performance of all vehicles, electronic systems, machinery and structures, both to the commercial economy and defense of the United States.

Our industry is a basic industry supplying all other industries, both for original manufacture and construction, and for service and maintenance during the life of the vehicle, machinery, end product, or structure.

Our industry is one of the first to be affected by any conversion to metric, and to the extent our industry is affected, there is a multiplier affect on all user industries.

The U.S. Census of Manufacturers shows that in 22 industries the assembly function, the use of our industry's products, represents more than 50 percent of total man hours of production.

Senator Inouye. May I ask a question at this point, sir?

Mr. Masterson. At any time, sir.

Senator Inouye. Have you had an opportunity to study the administration's proposal?

Mr. Masterson. No, sir.

Senator Inouye. I have read your statement, and it refers to the Pell bill.

Mr. Masterson. Yes, sir.

Senator Inouye. I would gather, as I have indicated to the prior witness, that your position would be one that would be in tune with the administration's proposal.

So, if at some later time, after studying the administration bill, you will favor us with your comments on that measure, we would appreciate it very much.

Mr. Masterson. We would be happy to do that.

Senator Inouye. I point out that the administration bill does not have the compulsion that the Pell bill has. It does not specifically say so, but it makes very clear that your industry, for example, need not be affected.

Mr. Masterson. Our industry will be affected under any circumstances. We are on the first line of any conversion. It is an extremely complex subject.

Senator Inouye. Even on the voluntary system? Right now it is voluntary.

Mr. Masterson. We are in favor of the voluntary system, yes. I thought you meant the problem itself was not complex.

Senator Inouye. No. The Pell bill, I suppose is the compulsory bill. It makes the SI system the only legal system, with some exceptions, in the United States.

Mr. Masterson. Yes.

Senator Inouye. Whereas the administration would authorize a dual system. It would provide metric studies in schools and so on, which we don't have at the present time.

But, please proceed, sir.

Mr. Masterson. Well, I am going to follow the suggestion you made that in the interests of saving time I would skip reading my prepared statement. I have a few notes I thought would put what I had in mind concerning conversion to metric into rather sharp focus in very little time for the committee.

In any conversion situation you have soft conversion and hard conversion. Soft conversion merely translates inch units to metric units and is proceeding rather rapidly in the United States in supermarkets for housewives and in other situations right now. U.S. packaging and labeling laws say you must put on the package or container the contents measured under the inch-pound system.

For example, Sunsweet Prunes are labeled by law on the container showing 12 ounces. They add voluntarily the metric equivalent showing 340 grams. This is a translation, or a soft conversion—the contents stay exactly the same.

Hard conversion is where you have a solid, and you change the form of that solid such as a screw thread system, recessed head-style or any other dimension. In this situation you need new engineering, which is costly and complex. You need new standardization to underpin engineering, both nationally and internationally.

You need new economics. You must determine whether we can afford the new system.

This morning a point was made that we had the opportunity in the United States for 180 years to go metric, but we refused to do so. During that 180-year period the greatest system of production, assembly, distribution, and consumption the world has ever seen was developed. There was no engineering nor economic advantage in "going metric." If there had been, our highly competitive economy would have long ago "gone metric."

Where it was economically practical to go metric in the pharmaceutical industry, they made this change. Pharmaceutical industry used metric in the laboratory and carried the new "language" into the marketplace. This was basically soft conversion.

Up to about 1960, the world was accustomed to "old metric." New metric, or System International, had really begun to develop since around 1964, and it is still high level discussion concerning both pure and derived units and nomenclature under the "new metric."

We are a basic industry that has a multiplier affect on all other industry. We are working extremely hard and rapidly on a voluntary basis with major multinational companies to develop an optimum metric system. The thrust of these hearings so far has referred only to a system of metric units for measurement, and have completely avoided new engineering, required standardization and economic evaluation.

The 3-year study bill on increasing use of metric in the United States stressed the fact that there should be engineering standards, engineering documentation and not just the use of bilingual units, which is the soft translation. The study demanded a review of hard conversion requiring new engineering, new documentation, new economic evaluation.

If this country goes metric, then it is the hard translation we are talking about—a costly translation in time, engineering talent, and change of manufacturing processes. It is misleading to U.S. citizens to do otherwise.

Much of the world's technology already has been translated from basic inch to adoption and adaptation throughout the world to old metric units.

The international major effort now is to work toward a one-world system of interchangeable parts stated in the new S.I. terms which are still evolving.

Our own industry took an innovative and novel position which was reported in full by the National Bureau of Standards hearings at Deerfield Academy, August 1970, which were attended by 49 technical societies and 31 trade associations. Our engineering report No. 1 was referred to in toto. We think our optimum metric fastener approach provides both an opportunity and incentive for the United States "to go metric," but on a voluntary basis only. We are not just talking about measurement, but engineering, standardization, documentation, and the harsh economic realities of the marketplace.

So there are two problems, soft conversion, which is proceeding apace in the marketplace, and very rapidly. It is also proceeding apace in the schools—on a voluntary basis—and we are very much in favor of this.

It is the hard-core heart of engineering, standardization, and economics where the United States does have leadership. It is here that we are working voluntarily with major multinational companies, not just fastener companies, but automotive, appliances, communications, construction, aerospace, machinery, defense, and others.

Because of pressures of your time and this committee, I did want to draw the difference between just measurement units, translation or transference of units, which is voluntary conversion, and the costs and complexities of hard conversion.

We do appreciate, Mr. Chairman, the opportunity you presented to us to make our statement, and we will answer now any questions you may have.

Senator INOUYE. Your statement will be made a part of the record at this point. The administration measure is a voluntary conversion. It concerns itself only with the units of measurement, volume, height, weight, et cetera, et cetera.

I would very much appreciate it if you will study that measure and share your views with us.

Mr. MASTERSON. Thank you very much, Senator.

Senator INOUYE. Thank you.

(The statement follows:)

STATEMENT OF FRANK MASTERSON, PRESIDENT, INDUSTRIAL FASTENERS INSTITUTE

I am Frank Masterson, President of Industrial Fasteners Institute which is an association of manufacturers of products in SIC 3452: nuts, bolts, screws, rivets and special engineered assembly components which are vital to the safe performance of all vehicles, electronic systems, machinery and structures both to the commercial economy and defense of the United States. Our industry is a basic industry supplying all other industries both for original manufacture and construction and for service and maintenance during the life of the vehicle, machinery, end product or structure. Our industry is one of the first to be affected by any conversion to metric and to the extent our industry is affected there is a multiplier affect on all user industries.

The U.S. Census of Manufacturers shows that in 22 industries the assembly function, the use of our industry's products represent more than 50 percent of total man hours of production.

The Industrial Fastener position regarding S. 2483 is:

(1) that notice for the hearings and time for preparation is unreasonably short especially in view of the magnitude of the subject and the impact on all elements of our society. There is no definite assessment representing what is best for the economy of the United States.

(2) The Bill is overwhelmingly comprehensive and detailed in areas that have an *unknown* and severely high cost to both the Government and industry without as yet known measurable benefits to the United States.

We oppose S. 2483 because it is premature, does not fully and properly evaluate advantages to the United States, disadvantages, costs and ability to recapture costs, and does not relate to the vital necessity to have meaningful voluntary consensus standards developed through the American National Standards Institute and ultimately presented to the International Organization for Standardization (ISO) for their consideration.

The Press Release for these scheduled hearings by the Senate Committee on Commerce regarding S. 2483 which would place our nation on a planned conversion program to the metric system of measurements arrived in our office February 23, 1972.

I called Counsel for the Committee, Mr. Henry Lippek at once and requested permission to make an oral presentation. Mr. Lippek said an oral presentation would be scheduled for me for March 1 under two provisions: (1) ten copies of the presentation must be received by the Committee Counsel 48 hours prior to the presentation or on Monday, February 28, and, (2) 100 copies made available at the time of presentation on March 1. Two of the allowed days, February 26 and 27 were Saturday and Sunday.

On a matter of maximum importance to United States Industry and the welfare of our country, this seems like short notice indeed. While the Press Release was dated February 18, a Friday, under normal circumstances it might be expected to be delivered February 21—this was a legal holiday with no mail deliveries.

Our basic industry has worked cooperatively for many years presenting our views before both House and Senate Committees considering legislation on conversion to metric.

We were heartily in support of the legislation which approved a three-year study by the National Bureau of Standards and our position presented to the National Bureau of Standards at a special conference called by them at Deerfield Academy in Massachusetts in August of 1970 is attached as Exhibit 1.

Digested, we feel United States fasteners standards under the present inch system are the best engineered, best documented and best proved-in-use worldwide. There is no incentive for the United States to change from this system and adopt conversion to metric.

As a progressive constructive and innovative recommendation, our industry voted to undertake a study to develop an optimum fastener system stated in metric terms. The National Bureau of Standards included our entire Engineering Report No. 1 in their presentation to the Secretary of Commerce regarding conversion to metric, attached as Exhibit 2.

Our study to develop an optium metric fastener system was to develop the maximum utilization of material and maximum simplification of choice. The system under study as a philosophy would then provide the *missing incentive* for U.S. industry to convert to metric. Our Engineering Report No. 1 indicates that U.S. Industry can develop a system that will provide a minimum of 25 percent enhancement in the utilization of material and up to 85 percent in the simplification of required *kinds* of parts vis a vis ISO. The Industrial Fasteners Institute requested the American National Standards Institute to appoint a special committee to study all of these involved engineering and economic considerations as they affect the best interests of the United States and hopefully all worldwide interests.

There is now a high level ANSI study committee to develop an optimum metric fastener system. The *results* of this study hopefully would lead to national standards and through ANSI a presentation would be made to ISO for their consideration.

As Exhibit 3, the announcement establishing the ANSI Special Study Committee is attached. Our optimum metric fastener program has top priority for many U.S. industries and is now proceeding on an urgent basis.

If the results of this fast paced indepth study indicates in fact an optimum metric fastener system is in the best interest of the United States *then* at that time a most important second step would be development of voluntary consensus standards through ANSI and through ANSI sponsorship, introduction of these standards to ISO for world-wide consideration.

The metric conversion problem is complex and proponents tend to over simplify the ease of conversion. The metric conversion problem is *not* similar to a decimal coinage conversion problem.

Every phase of every manufacturing activity is involved in conversion to metric. The present bill takes little or no cognizance of the importance of the needs of the market place in determining what industry can afford to *absorb* in additional costs, even if *some* of these costs to individuals and companies are made conditionally available by the Government.

In examining the result of metric on exports, there are several key points to remember: Total present exports of the United States include many items where metric is *not* a factor at all: liquids—chemicals, oils, etc.; scrap metals and materials; grains, and *bulk* factors including coal, ore, etc. Metric is an important factor in manufactured parts, machinery and in general manufacturing involving solids rather than liquids.

The need for any legislation at all at this time is a serious question which involves important and complex considerations for all manufacturers. There is still not sufficient data on a company-by-company basis to evaluate the best interests of the United States in conversion to metric.

The important study of the American National Standards Institute with the Industrial Fasteners Institute as administrative sponsor is continuing at a rapid pace. It is an attempt to determine and develop major significant engineering data to identify the role of national and international standards in the best interests of not only the United States but the world. The present legislation is premature. Much more engineering and economic data should be made available to the Congress before Congress can know costs, benefits, the possibility of meeting economically legislated time pressures.

Mr. Chairman, we appreciate the opportunity to request postponement of this legislation so that a comprehensive program can include specific and precise evaluation and recommendations affecting the best interests of our country can be incorporated in subsequent legislation. We are most happy to answer any questions proposed by your Committee. Again, thank you Mr. Chairman for permitting us to present our position.

INDUSTRIAL FASTENERS INSTITUTE

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Zimmer Manufacturing Ind. Inc.

INDUSTRIAL FASTENERS INSTITUTE,
Cleveland, Ohio, March 14, 1972.

Hon. DANIEL K. INOUYE,
U.S. Senate,
Washington, D.C.

DEAR SENATOR INOUYE: In all of its public statements, Industrial Fasteners Institute has consistently expressed its support for continued use by American industry of USA developed engineering standards for mechanical fasteners as based on customary inch/pound units of measurement.

IFI cooperated in the fact finding metric study conducted by the National Bureau of Standards. We studied each of the interim reports as issued, and the final report when it was released to Congress last July. Our opinion remains unchanged that a general conversion by the United States to the metric system of measurement would not necessarily be in the best industrial and economic interests of our country.

It is true that our Institute is now serving as administrative sponsor of the American National Standards Institute's project to study development of an optimum metric fastener system. Our deep and enthusiastic involvement in this important program should not be interpreted as an encouragement by our industry for a conversion to metric by USA based industry. Our purpose is strictly to assist any fastener using corporation which determines that it is in its own best interests to introduce metric module threaded fasteners into the design of its products. We want to make available to such companies a system of mechanical fasteners that technically will be superior to any other to which they might convert.

As you requested when I testified at the Senate Commerce Committee hearings on March 1, we have studied the Joint Resolution proposed by the Administration and have compared it with Senate Bill S. 2483.

We favor the less coercive approach adopted throughout the Joint Resolution; we agree with the formation of a National Metric Conversion Board; and we endorse the "voluntary" provisions of the Joint Resolution, especially the stated intention that the Board would be given no compulsory powers. The proposed timetable of 12 months to develop a national plan is reasonable, however, we suggest that the starting of the ten year period for conversion should begin when Congress accepts the national plan proposed by the Board.

In comparison with S. 2483, the Joint Resolution is more realistic. We appreciate your courtesy in providing IFI with this opportunity to present its views.

Cordially,

FRANK MASTERSON.

Senator INOUYE. Our next witness is the executive director of the American Home Economics Association, Dr. Doris Hanson.

STATEMENT OF DR. DORIS E. HANSON, EXECUTIVE DIRECTOR, AMERICAN HOME ECONOMICS ASSOCIATION

I am Doris E. Hanson, executive director of the American Home Economics Association. I am pleased to present the association's statement concerning metric conversion.

Since its founding in 1909, our association—a national educational and scientific organization with a membership of about 50,000 men and women—has consistently been guided by its purpose: to improve quality and standards of individual and family life through education, research, cooperative programs, and education to the public.

During most of this time the association and its members have been involved in some way in standards and measurement work related to consumer products. At the present time 25 members are active on national standards boards and committees.

In 1967, the association passed a resolution lending its support "to measures which promote the adoption and use of the metric system in the United States as they affect supplies and equipment used in the home by individuals and families."

I personally served on the advisory panel to the metric system study group appointed by the Secretary of Commerce and our association cosponsored with the National Bureau of Standards a National Metric Study Conference on Consumer Affairs on October 12–13, 1970. This conference probed all aspects of the issue of metrication as it would affect the consumer. There were about 200 people in attendance and this report is part of the NBS 457 report. It is our continued judgment that steps should be taken to bring about a conversion to the metric system and adoption of the system within 10 years as stated in the bill. I would like to summarize our position here. I would like, first of all, to summarize our findings relative to the probable effect of metrication on the consumer sector, and second, to discuss an important provision that we believe should be made in and bill that is passed—namely, the provision of funds for sufficient study of size and measurement standards to assure that we end up with a more rational consumer marketplace than we presently have. Simply converting to metric will not do that, the standards work must be an accompaniment.

First, then our findings in the consumer sector.

The participants at our 2-day conference examined five areas of consumer affairs—clothing, food, the home, transportation, and consumer attitudes. Also included were presentations on England's metrication experiences. Always the speakers approached their topic from the point of view of the consumer, rather than as a reseacher, teacher, or other professional.

CLOTHING

Beginning with the area of women's, children's, and men's ready-to-wear clothing, participants agreed that conversion to the metric system of measurement would provide the ideal opportunity to plan a more efficient structure for sizing, labeling, and categorizing apparel. Using body dimensions to size garments could make unnecessary the need for consumers to learn individual manufacturers' sizing and could bring consistency into the selection of slacks and undershorts, shoes and socks, for example. A more adequate system for marking clothing sizes could also increase the efficiency of mail-order companies and save consumers time, money, and frustration by reducing the number of errors made in selecting through the mail. Or we could add some prepackaged garments. A change in the metric system would offer a unifying factor between American and foreign manufacturers, many of whom must make special adjustments in their production and shipping procedures to accommodate the American system of measurements.

A planned system of metrication could offer opportunity to eliminate the confusing units currently used for price comparisons of foods in the food preparation and purchasing area. For example, equivalents of 16 avoirdupois ounces per pound and 32 fluid ounces per quart would be replaced by a more exact system without fractions. The U.S. monetary system, already decimalized, would correspond easily with the base of 10 used in the metric system.

Homemakers preparing their own baked products or other foods might find recipe conversions simpler in the metric system. Multiplication and division based on multiples of 10 should help them make quicker and more accurate computations. Professionals engaged in the development of diets, formulas, and recipes also might find their calculations facilitated.

Again, in the foods and foods-related areas, metrication would help to bring us closer to nations already on the metric system and could result in the international exchange of utensils and measuring equipment used in food preparation and in the establishment of international standards for sizing such cooking items.

The most economical method of conversion for homemakers would be for them to continue to use their present equivalent (ranges, electric portable cooking appliances, utensils) and recipes until they need or feel compelled to replace them. We believe simple conversion charts would make this possible. In the home, consumers who purchase major kitchen and home appliances and other large furnishings tend to make such purchases relatively infrequently. Items such as food freezers, air-conditioning units, ranges, and carpeting would be purchased in metric units and then the measurements most likely would not be referred to again.

However, even in this area manufacturers can still make improvements in the standardization of measures used for these items. Although the profusion of measurements needed for large purchases in the home does not inconvenience consumers frequently, they can, if incorrectly figured, cause frustration and loss of time and money. Floor carpeting, for example, is measured by the foot, yet sold by the yard.

In the event of conversion, home repairs and services would experience a period of duplicate tooling until all standard parts are replaced with metric parts. Although the United States will have some inconvenience using two systems for a while, foreign suppliers can eliminate their duplicate machinery and inventory systems designed for our customary measures. Such elimination could result in an eventual lowering of prices.

IN THE AREA OF TRANSPORTATION

Metrication in the United States was viewed as an opportunity for developing guidelines for standardization within some of the automotive gages and so on. I believe that was further elaborated in this document. The automotive specialists felt the need for uniformity and also we could do something esthetically also in changing over the road signs.

CONSUMER ATTITUDES

A common thread running through most sessions was the expectation of consumer apathy, indifference, and, mild resistance. The greatest problem is not in the metric system itself, but in the psychological difficulty of adjusting to something unfamiliar.

Here I would like to refer to the first part in this study. The Survey Research Center at the University of Michigan found that 33 percent of the general public that they interviewed was *in favor* of the metric system which is considerably higher than the estimates that were made both by professionals at our conference and that we have heard today. Actually, the apathy and indifference is not nearly as deep as we have a tendency to believe. We tend to regard the systems we use and are familiar with as best, and we are likely to resist changes until we are convinced that change is necessary or desirable. It was generally felt that a well-organized, cooperative effort would be needed which would combine the forces of government at all levels—business and industry, advertising and news media, and consumer organizations.

In all of our study, we did not find any place where metrication would increase the cost of living substantially nor cause hardship to consumers.

On the contrary there promises to be subtle benefits that can accrue in the consumer sector. Many citizens care deeply about our world posture and want us to be part of the family of man. To be in step with the language of measurement is a factor in that direction. There is also the educational saving in the sciences and in the early years of having to learn only one measurement system, rather than two as at present.

We should also consider the possible by-product of opportunity for standardization and the opportunity to rid the market of some of its confusing and misleading selling practices. The longing for progress in this area runs deep among consumers and consumer spokesmen.

And that point, Mr. Chairman, is the one I would like to emphasize as a second major item.

Today's consumers want a free market place in which they can make some kind of rational choice. We are beginning to see a bit of light with efforts toward unit pricing and nutritional labeling. But one of the real consumer needs is to restructure a good bit of our sizing and labeling system. "Going metric" will not accomplish that, but a paragraph in that direction should be added to the bill. You will double the advantage of metric conversion and cause the manufacturers only a one-time problem. The conversion can thereby result in a complete and good change from everyone's standpoint rather than a casual and chaotic one.

It is not easy in the market place to deal with sizes as we presently practice the art. You may wear a size 10 shoe, an 11 sock, a 14 shirt with a 40 long suit. Only some of which are related to measurement. We buy a 46-ounce can of tomato juice, a 15-ounce package of cereal and so on.

Most of the sizes are truly customary that is based at one time on an arms length, a lump, or the amount that would sell for a nickel. They are not appropriate for a scientific and technological age.

Because new directions will be set for hundreds of years hence it is important to the homemaker and to recipe writers to decide whether it is better for a liter to be divided in four cup-size parts as the quart is presently or to have five parts and maximize the advantage of the system of tens.

It is impotrant to the homeowner that the most efficient and economical system of modules be developed to replace the "two by four," the 30-inch or 3-foot items.

One of the most promising by-products of planned metrication can be to bring order to the consumer market place in a way that seems virtually impossible otherwise. But this will only happen if the bill specifically provided for this.

So we would therefore propose that in the bill as written under title I Metric Plan an item (8) be added.

(8) shall include a program for determining the most appropriate modules, measures, sizes and standards for all consumer products.

This work should include input from industry and Government as well as from consumer product specialists such as home economists. And it should consider international decisions already in existence.

In summary, then we would say that a planned conversion to the metric system will create no undue hardship on the consumer sector of society and in the long run promises to bring certain advantages.

"Going metric" will be of a special advantage to consumers if a more rational marketplace can be created in the process by paying definite heed to the need for concurrent planning and standards work related to dimensions and labeling.

Senator Inouye. Thank you very much, Dr. Hanson. That was my last call to vote, but I have decided to skip one. You people have waited long enough, so I will stay this time. Dr. Hanson, have you had the opportunity to study the bill which was submitted by the administration?

Dr. Hanson. No, sir, I haven't. I have only heard it discussed here today.

Senator Inouye. From what you have heard, would you be in favor of it?

Dr. Hanson. Well, I am not very clear on it.

Senator Inouye. For example the basic differences are these: Under the Pell bill subsidies are proposed. Under the administration measure you have no subsidies other than certain special cases which the commission may determine after hearings.

Dr. Hanson. May we take them one item at a time because I would respond to that first item. I am afraid I will lose the trend if we don't.

Senator Inouye. Yes.

Dr. Hanson. I worked with the Advisory Committee on this project leading me to believe that subsidies would not be appropriate nor wise except in the areas of education or standards-making bodies and so on where the funds are not forthcoming otherwise.

Senator Inouye. There is a second difference: the Pell bill would make the SI, or the metric system, the sole legal system in the United States with some exceptions, while the administration measure would make it our national policy to convert voluntarily to the metric system. We would have a dual system instead of one legal system as under the Pell bill. In the administration measure, there would be a dual system with the objective of making the metric system the predominant system in the United States in about 10 years.

Dr. Hanson. I am not familiar enough with the legal aspects of this. I would only say that as far as our present system, the present system is the preferred system at the present time. I understand that the metric system is not presently illegal but that in many instances the customary system is required on packaging and that sort of thing. I would—if the administration bill goes far enough to reverse that trend at a certain point in time, then I would favor that.

Senator INOUYE. The third difference, Dr. Hanson, the Pell bill has an element of compulsion; on the other hand the administration measure calls for voluntary conversion, recognizing the fact that there are certain industries which would suffer grievously if they were compelled to convert the metric system.

Dr. HANSON. Well, there again I think that with a certain reasonable time allowance that there should then become a point in time where the metric labeling would be the required labeling rather than our present customary system. I am not so optimistic to think that that would all come about automatically without some kind of fairly specific time conversion.

Senator INOUYE. I thank you very much again.

Dr. HANSON. Thank you.

Our next witness is the president of the National Small Business Association, Mr. Carl Beck.

STA EMENT OF CARL A. BECK, CHAIRMAN, METRICATION SUBCOMMITTEE OF NATIONAL SMALL BUSINESS ASSOCIATION

Mr. BECK. Thank you, Senator.

Good afternoon. My name is Carl A. Beck.

For the record, sir, I am no longer president of the National Small Business Association. I have been kicked upstairs to the chairman of the Metrication Subcommittee of the Legislative Policy and Action Committee of the National Small Business Association.

Senator INOUYE. Should I congratulate you, sir?

Mr. BECK. Well, I don't know. When you get to wearing a hat, you should keep wearing it, I suppose.

But I would like to, with your permission, sir, having submitted the testimony in writing and I presume you have it available, I am reluctant—I am reluctant to go through it and read it in detail.

Senator INOUYE. Without objection, your statement will be made a part of the record at this point.

Mr. BECK. And also, I trust, the addendum.

Senator INOUYE. Yes, sir, so ordered.

Mr. BECK. I would not read it through but make a few comments.

No. 1, if I may have the temerity to answer your question before you ask it, I have this morning briefly scanned a copy of the administration bill that I understand will be submitted.

I think that it appears to me—if you have read what I have said and compared it with the bill—that in essence, the administration bill seems to embody the most of the principles of what we are recommending here.

We have, of course, not had an opportunity to study it in detail but in general concept, it certainly seems to be the thing that we feel should be done.

There is so much that can be said on this question, I would like to, as I said in my testimony, limit myself to three items, first the impact on small business and second, the need for some action, and third. some recommendations such as policy and concepts such as are in the administration proposed bill.

As far as the impact on small business, Mr. Chairman, I must again remind you, if I might, that 97 percent of all business in the country are small businesses, even though we only have two of the 43 members on the panel in the National Bureau of Standards group.

Nevertheless, we are 97 percent of the businesses.

This has a tremendous impact on small business. The conversion period for most small business will last appreciably more than 10 years; and in our own business, the Charles Beck Machine Corp. in Pennsylvania, we can see that we will be under a dual system for at least 20, and more likely 30, years because of the vast number of machines that we have in the field that are receiving service and repair parts and so on, because we do have machines that have been out as much as 50 years and are still operating satisfactorily. It is good business to supply repair parts to these customers.

When you have been in business over a hundred years, you live on your reputation and integrity rather than styling and design changes, so that I think we overdo, from the viewpoint of products which do not have a factor of style or style obsolescence, this business of conversion at the time of new design.

For many of us this just isn't practical, and we will have to live with it a long time.

Senator **Inouye**. By the way, would it be possible for you to continue making these parts for the old machines that you have already produced even under conversion?

Mr. **Beck**. We would certainly do so, but the point I make is we will have to live under two systems.

As I mentioned in here, we have many drawings, although perhaps frequently revised, which may predate World War I, and we don't want to go to the cost of converting all these drawings to metric, and we will have to continue to work in customary units for some decades, so that we will have to be living under two systems. Do I answer your question, sir?

Senator **Inouye**. Are you suggesting we continue the status quo?

Mr. **Beck**. Definitely not. The cost of conversion, if it were to be done fairly rapidly, would be astronomical for our organization, yet we are strongly in favor of going metric.

As I outlined in here, one of the prime examples of what can be done is what the Industrial Fasteners Institute has done in developing this new system.

There are at present some 87 standard SI thread series, and if you combine them with the standard customary, you get approximately 140 official standard thread sizes, diameters and pitches, and so on, today.

There are actually, in the latest list I saw, 256. Now, what the Industrial Fasteners' proposes is to reduce this 256 to 25.

This means, in our own case, for example, instead of using 18 standard thread sizes as now, we would be reduced to seven or eight. This would be a considerable saving in inventory and even assembly costs, having such a limited selection.

The other thing is about the new series that has been developed by the Fasteners Institute, it is developed on the basis of end use application and it is a progressive series which is designed to fit the end use of what fasteners are to be used for; that is, to hold things together. It is an excellent system. Here is a real potential economy and we would be very anxious, for example, to use the new fastener system as soon as available, even perhaps if we were to use it on our replacement and repair parts, for example. On the other hand, as I mentioned in here in our survey of a hundred of our leading suppliers, we are amazed to find that the Steel Institute, or the steel suppliers and the manufacturers so far, have done nothing about setting new standards to go with the new metric bearings and parts that can be available and are being made available.

Unless Congress has some sort of statement of intent for the United States to move in this direction, it appears that organizations such as this are going to stay where they are. The status quo, as I have said, is frequently defined as "the mess we are in," and in some cases we are in a pretty bad mess.

If we can get metric bearings and metric parts but not metric shafting to fit these bearings, then we cannot really convert. We need a unified national statement of policy to encourage people to start moving in this direction. So I think this is why it is important that something be done at the present time.

Senator INOUYE. Now, under the administration's measure, I would believe that your company could continue business as is. It encourages voluntary conversion.

Mr. BECK. Yes. I would think so. I think, too, that if perhaps you have had a chance to glance through my report of the National Metric Study Conference, November 1970, the point I make in there is there are many reasons why it is practical and economical for certain areas to go metric.

Packaging, for example, there is an advantage to the retailer, certainly to the consumer. Certainly to those in favor of consumerism there is a real advantage to going metric. There is an economic advantage.

If we can move first in those areas where there is such an advantage, the economics, the general tenor of people's acceptance of the metric system will move much faster than if we were to go, for example, by the Pell bill, by trying to make it an edict and force it down our throats.

This is one of the reasons why I think that the administration proposal is so superior to the Pell bill.

Another thing, although the National Bureau of Standards has been so actively involved in the study, I think to put the prime responsibility on NBS is wrong. I think it is very important that this be a quasi-public body, if you will, on metrication matters, like Lord Ritchie-Calder has in England, which can pull in the various aspects of the private economy and correlate them. I think to have it a government bureau, part of a government bureau, is the wrong approach.

Senator INOUYE. The administration approach would establish an independent board.

Mr. BECK. That is correct. I think that is one of the reasons I say I feel that it is in line with our thinking as far as the concept and policy is concerned.

Senator INOUYE. So if you had a choice between the status quo and the administration approach, I gather you prefer the administration approach?

Mr. BECK. Very definitely.

Also, sir, I regret there has been no action on S. 1798. You recall we submitted testimony in writing in favor of this. I think this is very important.

As I have said, we have to make a decision. I said in my prepared testimony here that the metric report is called a decision whose time has come, and the decision "whose time has come" is whether we want to be a helmsman or a wheelbarrow, whether we want "to help guide our destiny or just be pushed around."

Unless we can move ahead and get organizations like ANSI and other competent trade associations involved in setting international standards, contributing the American know-how (which the world recognizes is very important) if we can get this involved, with the blessing of our Government, we can—as the Fasteners Institute is proposing and as Timken has done in their bearings—we can get standards adopted which are much more sensible, have economic benefit, and benefit from our vast engineering development. I think it is important we become involved rather than standing by the sidelines.

The few points I would like to make, sir, is that we should have a statement of congressional intent, so that people know which way the wind is blowing officially.

As we have said, I do not believe this is the Pell bill but it could well be the administration bill, such as the joint resolution. I think there has to be overall coordination and a metrification board or a metric conversion board of some sort. That is a necessity.

There are many things that I will not take time with but I could go into the problems that could arise interindustry, shipping versus manufacturing where there can be real knotty problems in various areas that have to be coordinated somehow.

There certainly should be the involvement of responsible trade organizations in international standard setting. There should be a Government policy on this, and above all, as I have said in my very last words, we have got to get moving on this because the longer the delay, the longer we are going to suffer.

Senator Inouye. With that, Mr. Beck, I would like to once again thank you for your contribution this afternoon. You can be assured that this committee will do something about this.

Mr. Beck. Thank you, sir.

Senator Inouye. I expect to, as soon as possible, after these hearings, urge the committee to report out the measure. I have my personal views as to what it should look like, but I don't think we are too far apart.

Mr. Beck. I don't think so.

Thank you for the opportunity to be present, and if there is any way our association can be of assistance to the committee, don't hesitate to have the staff call on us.

Senator Inouye. Thank you.

(The statement follows:)

Statement of Carl A. Beck, Chairman, Metrication Subcommittee of National Small Business Association

Mr. Chairman and members of the committee, my name is Carl A. Beck. I am chairman of the Metrication Subcommittee of the Legislative Action and Policy Committee of the National Small Business Association. I am also president of the Charles Beck Machine Corp., of King of Prussia, Pa., a manufacturer and marketer of capital equipment for the converting and packaging industries, with sales representatives throughout the world. This statement is presented on behalf of National Small Business, an association representing firms doing business in more than five hundred different industry categories. Because of the recognized and acknowledged impact of Metric Conversion on the small businessman, we have been keenly interested in this subject for some time, and we appreciate your giving us an opportunity to comment on this subject.

I am taking the liberty of including, as an addendum to my written testimony, copies of a paper entitled "A Small Businessman Looks at Metrication", presented at the Concluding National Metric Study Conference in November 1970.

Having only two days to prepare, limited time and resources have precluded extracting or copying this material, and we feel the vast majority of what we said then is equally germane today. In fact, my presentation today is an updating and extension of the basic principles set forth in that paper. My remarks here will not, therefore, deal with the specifics of any particular bill, but will be addressed to basic concepts and recommendations.

In particular, I would like to cover three areas: the impact on the small business, particularly the smaller manufacturer; the need for Congressional action and support; and recommendations for concepts and values which we feel should be incorporated in Congressional action. As a consequence I shall eschew any discussion of the aspects of education, consumerism (except as customers of small business!), the advantages to science, research, and engineering in general, and the myriad of other important aspects of our society.

I begin with a conclusion: metric conversion for the U.S. is inevitable! The only question remaining is one of timing: How soon? How fast? and How? Such a conclusion is inescapable if one reads the U.S. Metric Study, or has been involved during the preceding year, as I have, in meetings and seminars concerning metrification. Just as the year 1971 convinced the most skeptic person of the domestic ramifications of international finance, it also awakened many to the ineluctable internationalism of our socio-economic system. The "decision whose time has come" is whether we want to be a helmsman or a wheelbarrow—whether we want a hand in guiding our own destinies, or whether we are willing to be just "pushed around"

To say that small business is involved in the gross understatement of the year. Our company, for example, employs about fifty people and has annual sales approaching a million dollars (eliminating recession times like today), and we participated in the Metric Study as a respondent to the manufacturing survey. Our best estimates were that it might cost us as much as the amount of a full year's dollar volume of sales, to completely convert to metric measures! Even spread out over a ten-year period, this could be a substantial burden! Yet in spite of this, we recognize it must be done, and the sooner the better.

Much emphasis has been placed on conversion at model change or redesign. That may be relative in terms of an automobile, which is designed from scratch each model year, where the costs of new design and tooling are charged to each year's production, and production quantities would demand renewal anyway. But in a business such as ours, such a step by discrete step is not possible. Many of our machines in the field are still operating satisfactorily after forty years of service, and we cherish the reputation we have built up by servicing these customers. In a business which has been in existence more than a century, dependability and integrity count more than styling and planned obsolescence. Some of our drawings, although they may have been revised and changed many times, date back to pre-World War One, yet are still active and even stocked as repair parts for older machines, because it is economically feasible to do so. To add dual dimensioning and tolerances to many of these old tracings is not practical or possible, and they would have to be redrawn at monumental cost in manhours, or laboriously converted to metric practice at manufacturing, to fit a metric-oriented production shop after metric conversion had been accomplished. Of necessity, therefore, we will have some decades of working with both metric and customary units concurrently.

I know that our own problem is not atypical, but will be experienced by many small manufacturing concerns like us. The actual conversion of machine tools may not be exorbitant, but how about the loss of production time. A large manufacturer with dozens of boring mills may elect to change over 10% of them each year to metric feeds and dials. But the smaller manufacturer with *one* boring mill can't convert it stepwise.

I give these simple examples only to illustrate the impact of metric conversion—to quantify the costs is exceedingly difficult. The comparisons with larger business are somewhat self-evident, yet I remind you that of all U.S. businesses, 97% are small business! In the areas of retailing and consumer acceptance, I would also refer you to page 4, 5, and 6 of my addendum, with the illustrations of accommodation adaptation in the areas of packaging.

In light of such costs, problems, and apparent negativism, why then am I espousing the cause of conversion to the "SI" usage? Because there *are* long-range benefits. They may be difficult to identify, and almost impossible to quantify, but they do exist. You have heard about the current activity of the Industrial Fasteners Institute. As I have explained in the addendum (pages 7, 8, and 9), this could result in our inventory of bolts and nuts being reduced from eighteen thread types and sizes to perhaps seven, with a considerable saving in both production and inventory costs.

When discussing metrification, it is easy to be caught between the Scylla and Charybdis of oversimplification and overcomplication. The one who says railroad tracks will still be 4 feet 8½" apart even if measured with a meter rule is talking about "accommodation." The barmaid in the pub who demands a half-liter mug instead of selling a pint of bitter, is talking about unnecessary hard conversion. One is measurement, the other is standards changing. It should be emphasized that changing mensuration units and changing standards are two entirely distinct and separate things. To change units of measure only is costly, and of little real benefit, except to the scientists or designer, perhaps. But to change standards for benefit of those using them, when encouraged through a change in mensuration, is progress. I call to your attention that the new screw-thread series proposed by the Fasteners Institute is based on *use*, and is not only a simplification but a considerable improvement of the "status quo." In the addendum I give the example of trying to convert "12 gauge" to metric—a simple conversion chart for gauge from customary to metric dimensions would mean a table of some 4,256 entries! As I expressed then, this is not accommodation, adaptation, or conversion. It is called "stupidity." It lends credence to the belief that the "status quo" can frequently be translated as "the mess we are in."

Without further belaboring the issue, let me jump directly to a second conclusion: We know that new ISO international standards are being developed today, that U.S. superior technology *should* be involved, and that the rest of the world recognizes that also. We must not wait—we must begin now! The opportunity and the initiative can be ours if the U.S. is willing, but we can forfeit the opportunity to respond to the challenges by a too leisurely approach or prolonged inaction. If you would read page eleven of my addendum, you would note what I have just said is identical to what I said in November 1970. I believed it then—I am even more convinced of it now.

Some months ago your subcommittee had hearings on S. 1798, and we submitted a letter in support of this measure, the International Voluntary Standards Cooperation Act. This is an important matter, and I regret that it has not yet been approved by the Congress. A second step is a simple declaration of congressional intent, such as perhaps a Joint Resolution. In fact, I personally take exception to Senator Pell's Bill, S. 2483, in that it may go too far at this time. For example, I feel that the knowledge and data accumulated by the National Bureau of Standards in the Metric Study can be of real value, and the NBS should certainly be involved as a participant or an advisor for any National coordinating body, but I think it is wrong for NBS to have the prime responsibility. Lord Ritchie Calder admits that the British Metrication Board has indeed worked very well, and I think we shoud profit by their experience. We need the "flexibility" of a citizen's group, rather than a bureau or department of the government. In addition, government bureaus and ad hoc groups never die, and seldom seem to fade away, but a "metrification board" should have a terminal point.

But what is definitely needed is a statement of intent and a means of coordination. Let me illustrate by a personal experience. Our company recently sent a questionnaire about metric conversion plans to our hundred or so major suppliers. Ball bearings have historically been made to metric dimensions, and for many years our designers have labored with fitting bearings with metric bores to shafts with fractional inch dimensions. Tapered roller bearings, developed in this country, by the Timken Company primarily, have been in inch dimensions, but their new series of bearings are now designed to be used in both metric and inch relations. Much to our surprise, the steel companies are doing nothing, nor have they any plans, we are told. We can't begin to convert until we can obtain shafting in metric sizes. What the Steel Institute should do is take a fresh look, just as the Fastener Institute has done so well, and come up with a series of standard diameters which makes sense. People who are not in the machinery business are often astonished that common stock sizes are 1 3/16 and 1 15/16 inches, since the old time "turned, ground and polished" shafting was made from sizes on the even quarters of an inch, and 1/16" of diameter was lost in producing close tolerance shafting. But we are told that the steel makers are waiting to see what Congress will do.

In addition to coordination, there are other matters which must be resolved in some manner. Engineering drawings, as a part of the design function, are worth much more than drafting time involved, and are often capitalized in a manner similar to patents. But the cost of drawing conversion may loom so great that a company which has a capitalized drawing account may wish to expense the redrawing effort, and thus reduce taxes to compensate, in light of the fact that the conversion adds no value. Another concern which might customarily expense drawing preparation as part of production costs may feel such an expense too large for a single fiscal year, and capitalize such costs on the basis of future value after metric conversion. Is this to be determined solely by the Internal Revenue Service, or should some guidelines be established? We believe, as the Metric Study recommends, that "costs should lie where they fall", but we are loathe to see small business suffer unduly because they cannot bear significant burdens with the ease and dispatch available to larger concerns. The advanced technologies of computerized drafting machines and tape controlled machine tools of mass production are not necessarily practical for the smaller shop. I would hope, too, the Small Business Administration might be given authority for loans (*not* grants) to small businesses which might be caught in a catastrophic squeeze in a special conversion situation.

I have given only a sparse selection of examples of the impact and the opportunities confronting us in the area of metric changeover. I will be the first to admit that though the concept of metrification is deceptively simple, the implementation can be indescribably complex. There will be both hardships and "windfalls", I am sure. But the challenge cannot be avoided—it must be met, and the way we meet it will determine the benefit we can derive from the opportunity. If we are to give an adequate response to this challenge, I feel there are certain minimal actions which should be taken just as soon as possible, and I will therefore conclude with five recommendations:

1. There should be a simple and clear congressional statement of intent for the U.S. to "go metric".
2. A "Metrification Board" or similar group should be established, primarily of representatives of the private sector, to be responsible for coordination of plans and activities of the various segments and sectors of the economy, rather than an overall planning group for the economy, to encourage planning and involvement in the changeover at all levels.
3. There should be real encouragement for responsible trade organizations to become involved in coordinating and developing improved standards and practices in order to maximize potential benefits from the changeover.
4. Meaningful participation should be encouraged and abetted by such organizations as the American National Standards Institute and responsible trade associations working with them, in helping to shape and improve international standards, particularly with the ISO and IEC international organizations which now exist.
5. For my last recommendation, I again quote the last words of my paper in November of 1970: "Let's go!!!"

A SMALL BUSINESSMAN LOOKS AT METRICATION

(By Carl A. Beck)

An expert has been defined as someone 100 miles from home. Although I am more than 160.9 km or 86.8392487 nautical miles from home, I am afraid I don't qualify, however. The more I become exposed to the ramifications of "going metric", the less of an expert I seem to be! And though I am here today under the aegis of National Small Business, I must make it clear that the Association has as yet taken no "official stand" on the subject. On the other hand, we are very interested, concerned, and involved—and we are doing something about it. My comments therefore are primarily my own personal observations and conclusions, and should not be confused with the Association's present and future activities in the area of Metrication. We have not conducted any polls among our membership, because we saw it as an exercise in futility at this stage of time, but we will be soliciting their opinions and assistance as planning for metrication progresses.

As an individual, I am president of a small company which designs, manufactures, and markets worldwide, various kinds of capital equipment for the converting and packaging industries. We employ about fifty people in total, and our products are sold throughout the world by manufacturer's agents on commission. We do less than a million dollars annual volume, but are currently planning for the manufacture of one product line in Europe. I hope this categorization qualifies me to speak as an involved small businessman.

As we face the subject of U.S. metrication, we can identify certain principal elements, and recognize trends and variations which are very relevant to our situation. If we are to contribute information, knowledge, and judgment to help in national policy formulation (which is really the purpose of the U.S. Metric Study) we must consider the environment into which such a decision will be injected. Will you look at this environment for a moment through the eyes of a small businessman?

Following World War II, America thought it should rebuild the world, or at least re-establish new goals for its peoples. Today we are faced with a very different international politico-economic structure, and we would be wise to eschew activism for better planning: a longer-range view to the development of viable systems "to which the wise and just for all times may repair." But we need a deeper comprehension of what we can and cannot do. We must recognize the growing trend toward larger nationalism like the EEC and EFTA, as well as the charismas of national pride and language. We see a proliferation of American subsidiaries of foreign companies, and U.S. investments abroad today are more in direct investment than portfolios. Many small businessmen today feel this change, and recognize the need to look at their operations through "world-colored glasses". I am not trying to philosophize here; I am trying to underline the importance of the subject in the context of the political ecology of the future, facing us today!

It has been assumed that small business has just an ancillary interest in metrication, from the "fall-out" of international corporate giants. Not so! Bear in mind that 97% of U.S. business is small business. The world's largest corporation may go metric, but it has several thousand prime suppliers, almost all of which are small businesses. The U.S. Department of Commerce estimates show that at least 17,000 small manufacturers are exporters. Large corporations have the independence of choice in such things as metrication, and small business must accede; but small business has the versatility and dynamism to adapt to change, whereas to turn a big company around takes time. Wouldn't it be interesting if metrication were an area where small business could lead instead of following?!

This brings me to Postulate No. 1: *Metrication in the U.S. is inevitable.* As Corollary No. 1 would offer: *It is no longer a question of whether or when, but rather a question of how? and how fast?* If you can interpolate the broader considerations I have sketched above, you will reach the same conclusions.

The concept of U.S. going metric is deceptively simple, even though its implementation is involved. That it will be a major cost for small business cannot be denied. What these costs are is very difficult to quantify, but to quantify the benefits would be almost impossible. Yet there are benefits, and some of the more apparent ones can be at least qualified if not quantified. This leads me to what I would call Postulate No. 2: *Change should be undertaken, not in the way which seems easiest or which will provide fastest results, but in the ways that maximum benefits will accrue in the shortest practical time.*

For you to appreciate my reasoning behind this apparent tautology, some illustration is needed. Dr. Branscomb has lucidly, concisely, and definitively set forth the concept of the U.S. metrication process in a recent speech, which I commend to any novitiate who wants to understand what going metric means. There have been other excellent dissertations directed toward the effects on the consumer, the great need for education at all ages, as well as atomizing the problem into real or imagined roadblocks of catastrophic nature. I assume these statements are a matter of record, and will avoid a rehash of them here. But I would like to borrow the terms "hard" and "soft" conversion, "bilingual" measurement, and the concepts of "accommodation, adaptation, and conversion".

Accommodation we have been doing for years, and will continue to do. Greater accommodation (or easier accommodation) is basically a matter of education, yet education for change is not simple. We are talking of education in terms of value knowledge, and value knowledge or axiological learning is predicated on personal involvement.

Adaptation is basically a process of "soft conversion", and also a matter of education. I would imagine that metrication of weights and measures will be a real boon to those who dote on the current craze of "consumerism", but it certainly has real benefit for the housewife and shopper! To say, therefore, that "soft conversion" adds cost but not benefit is a "non sequitur", since it enhances marketability, and for the consumer, retailer, and consumer-product manufacturer, that is the "name of the game"! The retailer (particularly the small business retailer) in the U.S. is the world's expert on consumerism, because this is what lets him exist, and he will adapt with celerity to consumer preference. In today's supermarkets I find bananas and oranges sold by the pound, instead of the "hand" or by the "each" or "dozen", and I presume this is so the entire distribution chain can handle weight units from beginning to end, and thus shave costs an mark-ups without loss of profit or rounding allowances of conversion. The advantages lost in prepackaging of meats and cheeses were offset by shoppers' convenience and ability to choose. If the consumer understands the metric system, I feel that consumer objection is 95% myth. The "new math", for example, may confuse parents but it's here to stay because it makes sense. All of which brings me to Postulate #3: ***Since education for metrication is a major challenge, it should be accomplished first in those areas where, and by a program where, the average consumer can (1) be involved, and (2) appreciate a potential benefit.***

12 Gage

.028 AZG

.0283 SMW

.029 PASWG

.0472 MetWG

.0808 AWG, B/S

.0991 B.G.

.1040 Imp.SWG

.1046 Mfr Std. 489.6

.1055 ASWG, Roeb.

.1072 Stl., OH

.1084 Galv, SG

.109 OE

.1090 Stl. Elec.

.1090 BWG Stubs

.1094 Stl. 480

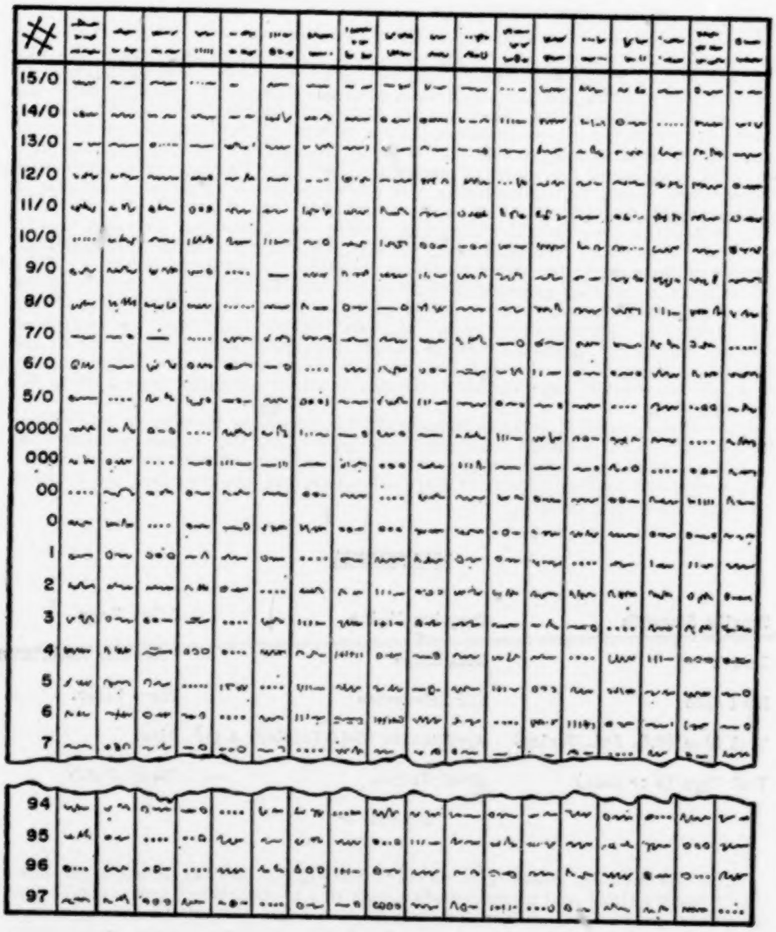
.1095 Ed WG

.185 Stubs WG

.189 ANSI TwDr

6530 Cir Mils

FIGURE 1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95
96
97

FIGURE 2

The obverse side of the coin is packaging and labeling, and provided it is done on a basis of voluntarism and convenience, it should *not* be a major problem. The conversion under the so-called "Truth in Packaging" Law was perhaps more onerous and difficult for the small food producer than dual marking for "customary" and metric units. When we get to "hard" conversion of package *sizes*, there may be such a customer demand for a "sampler" series of sizes under "our new system" that we may be running "to get on the band wagon". Conjecture? Perhaps, but not beyond the realm of possibility. So I offer Postulate #4: *Education for personal benefit begets evolution, and evolution begets conversion, because it utilizes the Profit Motive.*

Conversion is more than the change of package sizes, however, and real "hard" conversion has many imponderables. Let me jump to my own field of manufacturing, engineering design, tolerances, etc. I would presume that machinery manufacturing has probably as many difficulties in going metric as any portion of the economy. But the "status quo" is not all a bed of roses, either. "Status quo" was once defined as "the mess we are in." If I say "twelve gage" some may think of shotgun shells, but figure 1 shows 18 dimensions, all in inches, all of which are officially "12 gage". If that isn't bad enough, twelve gage is also 6,350 circular mills. Do we want to convert this to metric, as is, for all gages from 15/0 to 97? (see figure 2).

Since these are all standards, in accredited series, must we also, in converting, intersperse all of the sizes which are standard under the metric system? This is the approach that some people recommend: a kind of multiple accommodation-conversion bastardization. It may be unavoidable in some cases, but I would relegate it to a "last resort".

BOLT CRITERIA

Tensile Strength
Length
Head Size
Tool Size (U.S. Std. Series)
Tool Type (5 or more)
Torquing Limits
Head Shape
Fit Tolerances
Application (Self-Tapping, e.g.)
Shank Length
Point Shape
Vibration Resistance
Diam. Toler.
Diam.
Thread Pitch

FIGURE 3

Take the problem common to us all: "joining." Materials of all kinds have many fine qualities and characteristics, just like people. When you begin to join materials, particularly *different* materials, you begin to have problems, just as with people. I have never been able to decide whether mortar holds bricks closer together or further apart, but I do know it is needed to make bricks into a brick wall. So how we join things is the evolution of the universe, and I pick fasteners as a prime focus. Let's further simplify by eliminating, for the moment, rivets, catches, clamps, hooks, and everything but nuts and bolts. In fact, let's also ignore the nut. Now, as a manufacturer of industrial machinery, I have many concerns about a bolt. Figure 3 depicts fourteen common characteristics of a bolt or screw, in which I am interested as a designer, machinery builder and user of fasteners, approximately in their order of importance. There are established, accepted, excellent U.S. standards covering all these, as well as other more sophisticated characteristics. Thanks to organizations like the Industrial Fasteners Institute, our U.S. standards are better and more reliable than any in the world. At the bottom of my list are "diameter" and "pitch", yet this is what we think of *first* when we talk of screwthread metrication. Limiting our selection to just this one pair of characteristics, however, we find there are about 143 standard thread sizes in the U.S. Unified series, 75 in the ISO series as presently defined, and an additional 46 required to "bridge the gap" between U.S. and metric standard sizes. This assumes, of course, that the thread shapes are the same, which was assured during World War II, but these threads do not include square, Acme or other types of threads not normally used for "fasteners".

I will admit to having difficult in remembering that 17/64 equals 0.265625″, but I don't want to convert to metric by increasing the sizes or selections I have to inventory. There must be a better way! I am primarily interested in the *strength* of the bolt (its diameter) and how well it *holds* (pitch), and what I want is a spectrum of sizes which gives me enough choice to cover the range—but a practical minimum number, to reduce inventory requirements and all the concommitant cost of undue proliferation. Bless the Industrial Fasteners Institute, for this is what they propose: ". . . a series that would provide maximum utilization of material and a maximum simplification of choice with results stated in metric," and since it will conform to U.S. practices and technology, I might add, it will be superior to, but yet it will conform to, a worldwide standard. *If*, that is, *if* it will be accepted by those who are setting the standards for the SI system. Regardless of a possible desire for us to use "metric threads" on our machines abroad, where today both U.S. and metric threads are equally accepted, we will want to use this *new* series of fasteners as soon as possible, because it will cut costs and is intimately linked with that naughty word: the "Profit Motive".

By all common sense and logic, this should be the place for Postulate #5: *Hard conversion in manufacturing should focus first on those items where there is a predictable, even if unquantified, real economic advantage to the user.* As an important addendum I would offer a corollary: *There should be a maximizing of the use and involvement of responsible trade associations and similar organizations.*

I think, also, we are going to have a problem of identity. A good mechanic can identify a ¼–20 screw at a glance, but he may have difficulty in differentiating it from a metric M6.5 which would be only five thousandths of an inch larger in diameter, and only 20.3 instead of 20 threads per inch, but still might not fit a ¼–20 tapped hole! I would hope the new series will be enough different in some way, to obviate such a confusion.

We foresee other problems, of course. It is impossible to limit metric usage to only that which is new or redesigned, and the conversion of our own company drawings and technical data, we estimate, will stretch over about 20 years. I am sure that there are ways to computerize and then reproduce drawings, with dual dimensioning and bilingual notations, but not for our company in the foreseeable future.

Machine tool feeds and speeds are another problem, of course. Someone said he should go into the business of making "127 tooth gears", but he didn't say whether they would be made with teeth of 12 pitch (DP) or with a 0.4724 module (SI) tooth! Even dual dimensioning has a "Je ne sais quoi de complexite", and if you believe bilingualism is simple, just try to make a literal translation of the French phrase I just quoted. The opportunity for error is tremendous.

The concept of metrication is simple—the implementation is not. I hope you can appreciate why we have not "polled" our members. But later, if these postulates I have enunciated have any logic, our members can help advise the "where" and "how" of best approach. Since we are *not* a trade association, we cannot develop specific answers or systems, but just because we *are* different from a trade association, we may be able to help horizontally rather than vertically. Can we somehow help "coordinate" from the viewpoint of 97% of American businesses? With the help of NBS, ANSI, and the many wonderful trade organizations like IFI, perhaps we *can* do something. Our Executive Committee has recently, by formal resolution, approved the formation of a special Ad Hoc Committee on U.S. Metrication, and though we have not funds to dedicate to the effort, we are going to try to make some contribution, and perhaps become a bit "dedicated" in the process. Our first step will be an informal meeting in the near future, with selected representatives of other organizations, who are knowledgeable in this field and who might be willing to *help us* help the effort.

Any beyond that, we know that new ISO international standards are being developed today, that U.S. superior technology *should* be involved, and that the rest of the world recognizes that also. Although August 1971 is the NBS report date, Congressional action will take months or years after that. We must not wait—we must begin now! the opportunity and the initiative can be *ours* if the U.S. is willing, but we can forfeit the opportunity to respond to the challenge by a too leisurely approach or prolonged inaction.

So I would offer a last comment regarding a dynamic yet deliberate approach to intelligent planning and involvement, which I shall label Postulate No. 6: *Let's go* !!!

Senator INOUYE. Our next witness is Mr. William Roemer, executive secretary, Academy of Pharmaceutical Sciences.

STATEMENT OF WILLIAM ROEMER, EXECUTIVE SECRETARY, ACADEMY OF PHARMACEUTICAL SCIENCES

Mr. ROEMER. Thank you, sir. As you have stated, I am William C. Roemer, executive secretary of the Academy of Pharmaceutical Sciences of the American Pharmaceutical Association.

The American Pharmaceutical Association is the national professional society of pharmacists. Its approximately 50,000 members are composed of practicing pharmacists, pharmaceutical educators, pharmaceutical scientists, and pharmacy students.

The APhA is comprised of several subdivisions. One of these, the Academy of Pharmaceutical Sciences, provides an organization within the APhA for more than 2,000 pharmaceutical science members who are largely associated with our colleges of pharmacy, the pharmaceutical industry, government and private laboratories.

On behalf of its members the APhA and the Academy of Pharmaceutical Sciences supports the objectives embodied in S. 2483. We believe that these proposals provide for a smooth transition to the metric system in this country and that the adoption of the metric system and the standardization achieved thereby would greatly benefit the public, scientific, and industrial community.

Senator INOUYE. May I interrupt. That is another vote. I do not think I can afford to miss two in one day, so I will be back in 12 minutes. Until then we are in recess.

(Recess.)

Senator INOUYE. That was the final passage, so we should have some time for you, sir. Once again I apologize for the inconvenience, Mr. Roemer. Please proceed, sir.

Mr. ROEMER. On behalf of its members, the APhA and the Academy of Pharmaceutical Sciences supports the objectives embodied in S. 2483. We believe that these proposals provide for a smooth transition to the metric system and the standardization achieved thereby would greatly benefit the public, scientific, and industrial community.

This view has been supported by most research and scientific bodies in this and other countries for many years. In this connection, representatives of the APhA and the Academy of Pharmaceutical Sciences testified in 1965 in favor of S. 774 before this committee, and in favor of H.R. 2626 before the Committee on Science and Astronautics of the House of Representatives.

Then as now we know of no pharmacist or pharmaceutical scientist that does not support the adoption and use of the metric system. Resolutions to this effect have been unanimously approved on a number of occasions by the APhA house of delegates and the Academy of Pharmaceutical Sciences.

I think, Senator, rather than giving a verbatim statement, I would just as soon summarize the rest of the testimony.

Senator INOUYE. Without objection, your full statement will be made a part of the record.

Mr. ROEMER. Thank you.

The APhA publishes the Journal of Pharmaceutical Sciences, and in it, just as in many of the other scientific journals, we employ exclusively the metric system describing weights and measures. This permitted a standardization in print which was clear, concise, and universally understood by scientists throughout the world.

Although the metric system is not the oldest system of weights and measures, it is one of the most useful and easily learned since it is based on the decimal system. It offers convenience and clarity.

All of the units within the metric system vary regularly by a factor of 10. Even nomenclature is consistent and universally understood. Calculations to interchange units in the metric system become a simple matter which is convenient, easily understood, and less susceptible to error.

In the past the pharmacy profession in the United States has employed both the avoirdupois and the apothecary systems of weights and measures in the handling of medicines. In order to avoid confusion the community pharmacist had to clearly establish in his mind that the avoirdupois system was generally used in drug distribution other than on prescriptions. The apothecary system, on the other hand, was used to dispense prescriptions and sometimes to compound bulk medicine. The pharmacist thus acquired in the avoirdupois system and dispensed in the apothecary system.

These systems differed in that 1 pound avoirdupois was 7,000 grains and 1 pound apothecary was only 5,760 grains. Today the pharmacist employs the metric system. The medical profession also is employing the metric system. Doses are remembered, calculated and prescribed, and drugs are ordered, compounded, and dispensed in the metric system.

In this regard the use of the metric system by pharmaceutical manufacturers also has helped considerably in the conversion to metric practice.

While the 5-grain aspirin tablet is still familiar, the official dose is 300 milligrams in the metric system, and the apothecary equivalent essentially is only popular nomenclature.

Our association publishes the National Formulary, which is one of the official compendia recognized under the food and drug laws of both Federal and State Governments.

When this was first published in 1888 the system of measurement, of course, was that in vogue at the time, the apothecary system. Around the turn of the century it adopted the metric system and included parenthetically the equivalent doses in the apothecary system. However, since 1955 the apothecary equivalents have been entirely eliminated in the National Formulary. This is also true with the United States Pharmacopeia.

Each of the steps which provided for the orderly transition and familiarity with the use of the metric system in the practice of pharmacy have occurred over 40 to 50 years.

The transition was accomplished at this leisurely pace because:

(*a*) The metric system was less well known and accepted then than it is today;

(*b*) Many other countries and most of the other professions in this country utilized the English system:

(*c*) Except for its obvious facility of use, there was little driving force toward its adoption in the pharmaceutical field.

I might add that if I understand the remarks that have been directed toward the administration's proposal, I think here that this last point emphasizes the voluntary nature of this new proposal and would, I think, provide really little driving force to adopt the metric system in the United States within a fixed time period.

Thus we would end up within 10 years in spite of the fact that the proposal as I understand it hopes that it would be the predominant system of measurement, we would end up with the apothecary, the avoirdupois, the imperial, the troy, and throw in for good measure the metric. So we would have all these operating at the same time.

Senator **Inouye**. The Pell bill adopts the metric system as the sole legal system in the United States, with exceptions. It may possibly be a matter of semantics, but the administration resolution makes conversion voluntary.

Mr. **Roemer**. Yes, I understand that, Senator. But the nature——

Senator **Inouye**. In either bill one would have, to some degree, a dual system.

Mr. **Roemer**. Yes, I understand it. But I think without a coordinated effort or national plan to approach or convert the United States to the metric system that it will occur in a haphazard fashion and we will end up——

Senator **Inouye**. I believe both measures provide for this. In the Pell measure the leadership is centered in the Commerce Department.

Mr. **Roemer**. Yes.

Senator **Inouye**. In the administration measure you have a separate board composed of citizens appointed by the President. This Board in turn will formulate the conversion plans and programs and perhaps provide for grants and assistance where such grants are absolutely necessary.

Mr. **Roemer**. I think the basic difference is that in one there is a fixed time period set out 10 years in the Pell measure, and in the administration bill this is not provided for.

Senator **Inouye**. The administration bill sets a target of 10 years in which the predominant language of measurement will be the metric system.

Mr. **Roemer**. But it does not preclude the use of the other systems.

Senator **Inouye**. No.

Mr. **Roemer**. So we would be adding one more system to the measuring practices.

Senator **Inouye**. Neither does the Pell bill. It would have the metric system with exceptions, but the exceptions may be very large.

Mr. **Roemer**. That would have to be determined with time as to how large the exceptions would be.

Senator **Inouye**. Fine, sir.

Please proceed.

Mr. **Roemer**. Today we feel that the English system or apothecary system is so outdated that it is being abandoned in favor of the metric system even in England where it is initiated.

Although the use of the metric system today is not compulsory in this country, its use has been legal since 1966. Since 1893, the National Bureau of Standards has been authorized to derive the yard from the meter, and the customary or popular weights are referred officially to the kilogram, both of which are metric standards.

In the United States it is required that the metric system shall be used exclusively in the medical departments of the Army, the Navy, the Air Force, the Public Health Service, and the Marine Hospital Service of the United States.

The convenience of use and understanding of the metric system minimizes the possibility of error in calculations involved in many industrial operations. Since the early 1930's American pharmaceutical manufacturers have been converting their operations completely to the metric system. This has been done to provide better and more uniform control and thus greater assurance of safety to consumers of drugs from possible error which might arise in converting between one system to another.

It also has been done to provide better manufacturing efficiency through more intelligent and easily readable manufacturing forms, inventory records, cost analyses, and other recording devices which are maintained more uniformly in the metric system. These standardized and uniform records lend themselves readily to use in data processing equipment and modern business recording systems.

Senator INOUYE. May I ask a question at this point?

Have you found any noticeable change in the rate of errors made under the old system and under the metric system? Would you say that there were more errors under the old system?

Mr. ROEMER. You are talking in terms of manufacturing?

Senator INOUYE. Or in your business in dispensing prescriptions.

Mr. ROEMER. Well, I personally have not. Of course there is considerable literature that has been recently published by various groups bringing this point up that there are a number of medication errors. But they don't necessarily deal with the measure. The measurements involved in the giving of medications to patients is mostly errors of the type of giving the wrong medication to the patient. So I would have to answer no, that as far as errors with respect to measurement they are very infrequent.

Senator INOUYE. So the proportion of errors would be about the same under both systems?

Mr. ROEMER. Well, now, I would have to qualify my statement. If, say, for example, the medication was prescribed by the physician as a dose of *x* drug, 1½ grains, but the pharmacy within the hospital will say, supply the drug or the container that it is dispensed from labeled in terms of each dose in terms of milligrams and it is possible then there for that type of an error to occur.

Senator INOUYE. You are suggesting that if the whole system had been converted to the metric system that error would have been avoided.

Mr. ROEMER. That error would disappear.

Senator INOUYE. Instead of a grain and a half or say 90 milligrams.

Mr. ROEMER. In drawing from my experience we have spent a great deal of time and effort in teaching students all the different systems, conversions from one system to another. There are 15.432 grains in 1 gram, therefore 480 grains in 1 avoirdupois ounce, so the pharmacist is quite familiar with all of these systems although I think that I can say that he probably is most familiar and most comfortable in dealing entirely in the metric system because it is so simple.

Senator INOUYE. Thank you.

Mr. ROEMER. When the pharmaceutical industry made the decision to change to the metric system, they, of course, were required to provide metric scales in place of the avoirdupois scales, or reconvert their weighing equipment to be able to show metric subdivisions. Of course, it was necessary to replace the weights and measures with metric counterparts.

More difficulty was encountered in convincing the suppliers to the industry that the firm, the pharmaceutical firm wanted to purchase all of its raw materials in the metric system. However, as a customer service they did do this even though this required stenciling on the bulk packages of chemicals the metric equivalent.

Of course, the conversion process in the pharmaceutical industry also necessitated changes in product labels, packages, literature, catalogs, and other printed matter. This was accomplished over a period of time as new printing was required. Frequently both the metric and avoirdupois and apothecary equivalents were shown. Most of the pharmaceuticals marketed in the United States are labeled in metric units; however, much of the equipment used in their manufacture is still designated in terms of the familiar inches and gallons.

For example, the dies that are used in tablet machines are still designated in terms of inches. A 1-inch die in the metric system would become a 2.54-centimeter die. But this would not necessarily require that the entire piece of equipment be thrown out and replaced with an exclusively metric engineered piece of equipment. It would in time as machines wore out that they would be replaced with metric-engineered machines.

In conclusion, I would like to say that in the event that S. 2483 is enacted, perhaps the Department of Commerce would wish to consider studying the conversion that has taken place in the pharmaceutical industry as a tested and proven model. We believe that here would be illustrated the real and imaginary problems that would be encountered in other fields of endeavor, also here I think that their experience would be shown, would show the way other industries can overcome their problems.

The pharmaceutical scientists and the profession of pharmacy welcome the opportunity to serve the Nation by sharing our knowledge and experience as to how conversion to the metric system could be achieved. The pharmacy practitioner could be of great assistance in educating the public in understanding as well as acceptance of the metric system. The daily contact the pharmacist has with the public provides him with a unique opportunity in this regard.

Teaching every child the interrelationships between the English, the avoirdupois, the troy, and the metric system, and other miscellaneous equivalents, is no small accomplishment. Most people today attain adulthood without being able to convert these interrelated quantities with ease and confidence. Those who may say that the housewife who has learned the present American or English system of weights and measures would have difficulty in learning a new system do not give the housewife proper credit. If she could learn our present system, she should have no difficulty at all in learning the metric units.

Mr. Chairman, on behalf of the American Pharmaceutical Association and its Academy of Pharmaceutical Sciences, we appreciate this opportunity to present their thoughts on S. 2483 to this committee. We would welcome the opportunity to be of the assistance to Congress and the public on this important matter, and will be happy to try and answer any questions you may have.

Thank you.

Senator INOUYE. Thank you very much, sir.

It has been suggested by some that conversion would be a very expensive matter. In your industry's experience did you find conversion to be an expensive change.

Mr. ROEMER. In preparing my testimony for presentation today I anticipated that question, Senator, and I made specific inquiries to people who would be—hopefully, I thought—in a position to answer those questions. Unfortunately, it was the consensus of the several that I spoke to that since this has been such a gradual process, starting in the early thirties, reliable figures are simply not available.

I think we realize that in converting to a new system of measurements that there will be costs involved. We heard this morning several estimates. I think of one being $45 billion, and another being $60 billion. Of course, I have no way of knowing whether or not these are fair estimates of the cost.

Senator INOUYE. I would assume that your conversion was done without Federal assistance?

Mr. ROEMER. Yes, it was, it was entirely voluntary.

Senator INOUYE. Then would you feel that all conversion in the United States should follow the principle of letting the costs lie where they fall?

Mr. ROEMER. Well, I——

Senator INOUYE. In other words, the companies should absorb the cost.

Mr. ROEMER. Yes, I favor that approach with a qualification. That if there are industries, as the conversion progresses, who experience particular difficulty and it is a particularly undue hardship, that provision be made for providing for this type of contingency.

Senator INOUYE. Once again may I say how much I appreciate your statement this afternoon and your patience in waiting this long.

Mr. ROEMER. That is all right.

Thank you very much.

(The statement follows:)

STATEMENT OF WILLIAM C. ROEMER, M.S., J.D., EXECUTIVE SECRETARY, AMERICAN PHARMACEUTICAL ASSOCIATION, ACADEMY OF PHARMACEUTICAL SCIENCES

Mr. Chairman, members of the Committee, I am William C. Roemer, Executive Secretary of the Academy of Pharmaceutical Sciences of the American Pharmaceutical Association. Accompanying me today is Dr. Edward G. Feldman, Associate Executive Director for Scientific Affairs, APhA.

The American Pharmaceutical Association is the national professional society of pharmacists. Its approximate 50,000 members are composed of practicing pharmacists, pharmaceutical educators, pharmaceutical scientists and pharmacy students.

The APhA is comprised of several subdivisions. One of these, the Academy of Pharmaceutical Sciences, provides an organization within the APhA for more than 2000 pharmaceutical scientist members who are largely associated with our colleges of pharmacy, the pharmaceutical industry, government and private laboratories.

On behalf of its members the APhA and the Academy of Pharmaceutical Sciences, supports the objectives embodied in S. 2483. We believe that these proposals provide for a smooth transition to the metric system in this country and that the adoption of the metric system and the standardization achieved thereby would greatly benefit the public, scientific and industrial community. This view has been supported by most research and scientific bodies in this and other countries for many years. In this connection, representatives of the APhA and the Academy of Pharmaceutical Sciences testified in 1965 in favor of S. 774 before this Committee, and H.R. 2626 before the Committee on Science and Astronautics of the House of Representatives. Then, as now, we know of no pharmacist or pharmaceutical scientist that does not support the adoption and use of the metric system. Resolutions to this effect have been unanimously approved on a number of occasions by the APhA House of Delegates and the Academy of Pharmaceutical Sciences.

The metric system provides a common language, permits precise reproducibility of experimentation, and enables the development of similar standards. The APhA publishes the *Journal of Pharmaceutical Sciences*, an internationally-known and respected scientific publication. This journal reports original laboratory studies and scientific reviews in the pharmaceutical sciences. Today, manuscripts published in our journal, just as in many other scientific journals, exclusively employ the metric system for describing weights and measures. I point this out because the use of the metric system in scientific publications in pharmacy, chemistry, and biology generally, has permitted a standardization in print which is clear, concise, and universally understood by scientists throughout the world.

Although not the oldest system of weights and measures, the metric system is one of the most useful and easily learned since it is based upon the decimal system. It offers convenience and clarity. All units vary regularly by a factor of ten. Even nomenclature is consistent and universally understood. In metric length, for example, a decimeter is one-tenth of a meter, and a dekameter is 10 meters; in metric volume, a deciliter is one-tenth of a liter and a dekaliter is 10 liters; in metric weight, a decigram is one-tenth of a gram, and a dekagram is 10 grams. Similarly, when the dose of a drug is one milligram and a supplier provides the drug in one gram vials, he provides 1,000 one milligram doses. When the drug manufacturer produces the drug in 10 kilogram lots, since one kilogram equals 1,000 grams, then 10 kilograms equals 10,000 grams; since one gram equals 1,000 milligrams, then 10 kilograms equals 10,000,000 milligrams or 10 million doses. Calculation to interchange units becomes a simple matter that is convenient, easily understood, and less susceptible to error.

In the past, the pharmacy profession in the United States has employed both the avoirdupois and the apothecary systems of weights and measures in the handling of medicines. In order to avoid confusion, the community pharmacist had to clearly establish in his mind that the avoirdupois system was generally used in drug distribution other than on prescription. The apothecary system, on the other hand, was used to dispense prescriptions and sometimes to compound bulk medicine. The pharmacist thus acquired in the avoirdupois system and dispensed in the apothecary system. These systems differed in that 1 pound avoirdupois was 7,000 grains and 1 pound apothecary was only 5,700 grains. Today, clearly, the pharmacist is being taught to use and does use the metric system. The medical profession also is employing the metric system. Doses are remembered, calculated, and prescribed, and drugs are ordered, compounded, and dispensed in the metric system. In this regard the use of the metric system by the pharmaceutical manufacturers also has helped considerably in the considerably in the conversion to metric practice. The 5-grain aspirin tablet is still familiar, but the official dose is 300 milligrams in the metric system, and the apothecary equivalent essentially is only popular nomenclature.

The metric system today is universally employed by all modern pharmacopeias. The APhA publishes the *National Formulary*, which is one of the official compendia recognized under the food and drug laws of the Federal and State governments. When the *National Formulary*, first began publication in 1888, the system of weights and measures employed in the compendium then, reflecting the practice of pharmacy of that period generally, was the English or Apothecary system. Around the turn of the century, the pharmaceutical profession began recognizing the need for and value of a change to the metric system. This was reflected in the use of the metric system in the *National Formulary* published about 1900, which listed both metric and apothecary weights and measures, side by side in tabular form, under each monograph or description for drug sustance or drug composition. This was the first official step by the APhA to convert the practices in American pharmacy from the apothecary to the metric system of weights and measures. Subsequent editions of the *National Formulary* then emphasized the metric system, although for several revisions the equivalent to the metric dose was frequently given parenthetically in apothecary weight or measure. The use of apothecary equivalents in the *National Formulary* was deleted entirely with the publication of the 10th edition in 1955. In 1890 the United States Pharmacopeia adopted the metric system of weights and measures exclusively, except for the statement of equivalent dosage, and then deleted even this in its 1955 edition.

Such steps provided for the orderly transition and familiarity with the use of the metric system in the practice of pharmacy over a period of some 40 to 50 years. The transition was accomplished at this leisurely pace because:

(a) the metric system was less well known and accepted then than it is today;

(b) many other countries and most of the other professions in this country utilized the English system;

(c) except for its obvious facility of use, there was little driving force toward its adoption in the pharmaceutical field;

(d) because of the precedent setting nature of the conversion by the entire pharmacy profession and industry, it would be expected that each step would be taken with great care and progress would be slower.

Under prevailing conditions of education, interest, and world conditions, we would anticipate that other professions and industries within the United States could, and would, achieve the conversion far more rapidly. Today the English system or apothecary system is so completely outdated that it is being abandoned in favor of the metric system, even in England where it was founded.

As we have noted, although the use of the metric system today is not compulsory in this country, its use has been legal since 1866. Since 1893, the National Bureau of Standards has been authorized to derive the yard from the meter, and the customary or popular weights are referred officially to the kilogram, both of which are metric standards. It is required that the metric system shall be used exclusively in the medical departments of the Army, the Navy, the Air Force, the Public Health Service, and the Marine Hospital Service of the United States.

In 1944, the Council on Pharmacy and Chemistry of the AMA adopted the metric system for exclusive use in its publication, *New and Non-Official Remedies* (now titled *New Drugs*). The metric system also is used by many other professional groups, although unfortunately not exclusively, because of practices passed on from generation to generation in the fields of engineering, technology, and even commerce.

The convenience of use and understanding of the metric system minimizes the possibility of error in calculations involved in many industrial operations. Since the early 1930's American pharmaceutical manufacturers have been converting their operations completely to the metric system. This has been done to provide better and more uniform control and thus greater assurance of safety to consumers of drugs from possible errors which might arise in converting between different systems.

It also has been done to provide better manufacturing efficiency through more intelligent and easily readable manufacturing forms, inventory records, cost analyses, and other recording devices which could be maintained more uniformly in the metric system. These standardized and uniform records today lend themselves readily to use in data processing equipment and modern business recording systems.

In pharmaceutical firms the conversion of manufacturing operations to the metric system generally has been a relatively easy matter. It was necessary to provide metric scales in place of avoirdupois scales, or reconvert weighing equipment to show metric subdivisions; it was also necessary to replace weights and measures with metric counterparts.

More difficulty generally was encountered in convincing chemical suppliers that a firm wanted to purchase all of its raw materials according to the metric system. But even here, the experience has been that suppliers have readily agreed to sell and bill their materials in metric equivalents because this was what the customer wanted. Frequently, even today, bulk containers of chemical and drug materials purchased for pharmaceutical manufacture will show both the metric quantity and the avoirdupois equivalent. Even sugar and salt, which are food staples, are purchased for pharmaceutical use by metric weight even though the bags may be stenciled to show that weight.

The conversion process in the pharmaceutical industry also necessitated changes in product labels, package inserts, catalogs, and other printed matter. This was accomplished over a period of time as new printing was required, and frequently both the metric and avoirdupois or apothecary equivalents were shown.

In spite of the fact that most of he pharmaceuticals marketed today are labeled in metric units, much of the equipment used in their manufacture are designated in terms of inches, gallons, etc. For example, the dies used in tablet machines are designated in inches. Adopting the metric system would require a relabeling in metric units. A one-inch tablet die would become a 2.54Cm tablet die but would not require replacing the entire tablet machine. This same reasoning would apply to other manufacturing equipment as well.

In the event that S. 2483 is enacted, perhaps interested persons, including the Department of Commerce, would wish to consider studying this conversion in the pharmaceutical field as a tested and proven model. Here would be illustrated the very real (and the imaginary) problems in other fields of endeavor. Here, also, would be shown the way to overcome them.

Pharmaceutical scientists and the profession of pharmacy welcome the opportunity to serve the nation by sharing our knowledge and experience as to how conversion to the metric system could be achieved. The pharmacy practitioner could be of great assistance in educating the public in understanding as well as acceptance of the metric system. The daily contact the pharmacist has with the public provides him with a unique opportunity in this regard.

Teaching every child the interrelationships between the English, the avoirdupois, the Troy, and the metric system, and other miscellaneous equivalents, is no small accomplishment. Most people attain adulthood without being able to convert these interrelated quantities with ease and confidence. Those who may say that the housewife who has learned the present American (English) system of weights and measures would have difficulty in learning a new system do not give the housewife proper credit. If she could learn our present system, she should have no difficulty at all in learning the metric units.

Mr. Chairman, the American Pharmaceutical Association and its Academy of Pharmaceutical Sciences, appreciate this opportunity to present their thoughts on S. 2483 to the Committee. We would welcome the opportunity to be of assistance to Congress and the public on this important matter, and will be happy to try and answer any questions you may have.

Thank you.

Senator INOUYE. Our final witness is Mr. Thomas A. Hannigan, International Brotherhood of Electrical Workers.

STATEMENT OF THOMAS A. HANNIGAN, DIRECTOR OF RESEARCH AND EDUCATION, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

Mr. HANNIGAN. Thank you, sir.

I am Thomas Hannigan, director of research and education, International Brotherhood of Electrical Workers, the world's oldest and largest electrical union with a membership of almost a million, with 1,800 local unions in the United States and Canada.

As a result of my participation on the National Metric Advisory Panel and exposure to the problems associated with conversion to the metric system, we are strongly opposed to a 10-year planned conversion period. This opposition is based on our inability to identify any major advantages arising from conversion to the metric system and the glaring lack of information regarding its impact on a trillion dollar economy.

Several months back, a Wall Street Journal article stated I was lonely with these views, but at the last meeting of the advisory panel, I felt my views and criticisms had gained strength and were supported by many of the members of the panel.

We have four major criticisms of the report—first, the U.S. Department of Commerce report on the U.S. metric study is much too narrow; second, it is blatantly biased in favor of conversion to the metric system; third, there are insufficient real evidence to support the recommendation for a 10-year period; and fourth, the recommendation to let the costs of conversion lie where they fall will impose an extreme hardship on those individuals and organizations least able to afford them.

I will expand on each criticism in order—first, the study took too narrow a view. In spite of obvious difficulties, a serious attempt should have been made to analyze the impact of metric conversion from a macroeconomic viewpoint, as well as a microeconomic viewpoint.

Conversion to the metric system must be analyzed in its proper perspective, if we are to make sound decisions. The frequent analogy between the United Kingdom and the United States completely distorts the scope of the undertaking. It is like comparing a rockfall to an avalanche.

On one hand, we have the United States with its $1 trillion economy; on the other, we have the United Kingdom with an economy of little more than $100 billion.

Furthermore, in respect to the Common Market, the U.S. economy is two-thirds greater than the combined output of both the Common Market and the European Free Trade Association. The United States-United Kingdom analogy deteriorates further when one considers the types of national economies.

The United Kingdom is an island nation whose very existence depends on international trade. On the other hand, exports account for less than 5 percent of the U.S. gross national product. Also, the desire of the United Kingdom for admission into the Common Market strongly influenced their decision to metricate.

In short, we are dealing with a gigantic economy in the United States, and it is growing every day. Given full employment, it should reach $1.3 trillion in 1975, and $1.6 trillion in 1980.

Therefore, any comparison of the U.S. economy to other national economies is grossly inappropriate and will inevitably result in disastrous decisions.

The U.S. metric study was limited to an industry-by-industry analysis. While most respondents indicated they will be able to adjust to the obvious costs and burdens of the metric system, little consideration has been given to the sum total of their respective impacts on our economy.

Such folly is equivalent to rightfully assuming that a crowded theater can be emptied in an orderly fashion by two or three people passing through the exits over a sufficient period of time, but ignoring the panic and ensuing tragedy which results in an emergency when everyone rushes to the exits at once.

Now, imagine the U.S. economy in the fourth or fifth year of a 10-year planned conversion, the point of no return, being confronted with the economic conditions of the past 3 years. We have experienced soaring prices—up over 12 percent in the last 36 months—increasing unemployment, tight money, a serious profit squeeze, corporate liquidity problems, an unplanned budget deficit, a decrease in industrial production and business activity, a painfully slow recovery, plus a $2 billion balance-of-trade deficit—our first since 1893.

We now have a 6-percent unemployment rate with no relief in sight; we are involved in an international monetary crisis, plus inequitable and unworkable wage and price controls. Add to these economic problems of the past 3 years the costs and dislocations associated with conversion to the metric system, and, instead of experiencing a period of economic stagnation, we would have experienced total economic chaos.

In brief, conversion can only be accomplished in a balanced full employment, stable economy, which must be maintained throughout the entire conversion period. This best of all economic conditions has never been achieved for long, and our present-day economic game planners seem unable to accomplish it even briefly.

In a strained economy, the cost of conversion to the metric system would intensify the inflationary pressures; in a slack economy, it would impede and possibly preclude recovery.

Thus, one of the principal limitations to conversion is our inability to successfully manage our economy throughout the extremely difficult conversion period.

This study gives little, if no consideration, to the impact of metrication on our social and cultural values. This is a most unfortunate oversight because today our society is in a continuous state of flux. Our traditional values and priorities are being seriously questioned by all segments of society.

I feel certain, given the enormous and urgent problems presently confronting this Nation, the general public would assign a $60–$100 billion conversion to the metric system the lowest priority. Without public support, metrication does not stand a chance. As the costs and disruptions grow with increased use of the metric system, initial public reservations would rapidly become public rebellion.

We want to stress the need for an objective study to measure the intensity of the negative effects of conversion to the metric system on our Nation. The negative effects of conversion include both economic and social cost. It is very possible the impact of these costs is entirely different.

The timing of the conversion determines the intensity of each cost separately and their combined impact on society. The longer the transition period, the lower the social disruption, but the higher the economic costs.

Senator Inouye. Before we proceed with the rest, how did you reach this $60–$100 billion figure?

Mr. Hannigan. From the various reports submitted. There are various ways of adding them up. Sixty billion would be one estimate. One hundred billion dollars would be another, maybe not the highest. I have seen them up to $200 billion, but it depends on the method of the pricing it out. Sixty could be extracted from data in the report as it is now, using the upper ranges that have been submitted.

Senator Inouye. Have you seen the administration measure?

Mr. Hannigan. No, Senator, I haven't. I heard of it just as I walked in.

Senator Inouye. Has the IBEW made any documented studies to estimate the social, economic, and public costs?

Mr. HANNIGAN. No, Senator, that is why we are asking that it be done. It is an enormous undertaking.

Senator INOUYE. Are you suggesting the metric study was inadequate?

Mr. HANNIGAN. Completely inadequate, Senator. It hasn't touched on the social costs and disruption to our culture.

Senator INOUYE. We have had consumer representatives stating that it would enhance social values here.

Mr. HANNIGAN. I could disagree with that, I think it could develop into serious problems.

Senator INOUYE. Please proceed, sir.

Mr. HANNIGAN. My second criticism concerns the pro-metric bias of the final report. This bias is found throughout the report in the techniques applied, semantics, sentence structure, and the subordinating of key issues—ignoring or subordinating negative findings and confusing editorial opinion with facts.

No effort is made to distinguish between the very few true benefits which are a direct causal consequence of conversion to the metric system from those which are merely possible indirect opportunities.

Senator INOUYE. May I interrupt there, also?

In reviewing the metric study, we note in the cost-benefit chapter the following words:

> The assumptions as to benefits and costs were made on a worst case basis. That is to say, when a choice was possible, it was made so that the no-plan mode of changeover—which is status quo—was put in the best light.

Do you feel that the drafters of the statement erred when they wrote that?

Mr. HANNIGAN. I think so, yes, I think they always took the more optimistic viewpoint throughout my report and throughout my experience on the advisory panel.

Senator INOUYE. Then you are saying the drafters were correct. According to the metric study report, they always gave the status quo the benefit of the doubt. Do you believe that was so?

Mr. HANNIGAN. In general, no. I am not familiar with the quote you have right now, but in general, they haven't given the status quo the benefit of the doubt in most of that study. I am saying it was bias pro-metric report.

Senator INOUYE. Are you suggesting the statement is not correct?

Mr. HANNIGAN. Right.

Senator INOUYE. Please proceed, sir.

Mr. HANNIGAN. I have also had serious reservations about the quality and objectivity of the technical reports. The most important observation of the entire study is found in the U.S. metric study report on international trade.

It states, "The notion that the United States is losing exports to metric countries because its products are not designed and manufactured in metric units appear to be ill-founded."

This finding is inadequately stressed and the report conveniently proceeds without sufficient reason or qualification to continue with unsupportable conclusions and predictions on international trade.

In each of these technical reports, there is much evidence of a pro-10-year conversion period bias and many technical shortcomings and inadequacies are easily identified.

Also, the study fails to adequately identify underlying assumptions and limitations of technical reports. Some of the basic criticisms of the advisory panel, as I recall, the standards report tied success in establishing standards too closely to conversion to the metric system; the Education Reporter is principally an effort to promote educational reform; and, worst of all, the International Trade Report ignored the economic hardships and dislocations involved in the transition period.

I also feel that the theme of the informed consensus, which is emphasized throughout the report, is severely abused. The report's statement that "over the course of study, almost every American can have a chance to speak or be spoken for" is absolutely absurd. Public opinion polls indicate that most Americans are not even aware of the metric system.

The fact is the U.S. public, business, and labor have no real need for or desire to force metrication. The report ignores this finding and rationalizes that once the ignorance of the population is overcome through public education efforts, there will be universal support for the metric system.

Condescension of this type is all too characteristic of many supporters of the metric system. They obviously believe that they are the most qualified to decide what is beneficial for this Nation. This elitist attitude discourages criticism and further thought and is most unfortunate, especially when so much remains unknown about such an extremely important subject.

Senator **Inouye**. I suppose that is the attitude all proponents take, whether labor or management, bureaucrat or politician, they believe the cause is right, and they feel they have the solution for the rest of the world.

Mr. **Hannigan**. I imagine so, supporters of any cause, must believe strongly in their cause.

The entire labor section is misleading. The statement that part or all union members made at least some use of the metric system is completely meaningless, since use lacks definition.

Also, the statement that 40 percent of the representatives were in favor of a planned national program is simply untrue. Most saw few direct advantages, but many disadvantages such as the cost of retraining, replacement of tools, loss of experience, loss of earnings, and restricted promotional opportunities.

Several major unions vehemently opposed conversion and consider it disastrous. Briefly, an accurate summary of labor's position was concern for the well-being of its members and the well-being of the country.

Senator **Inouye**. Before proceeding, I noted in your presentation, you have been skipping some sections. Do you wish to have the statement made a part of the record in full?

Mr. **Hannigan**. Yes; I cut down a few places to conserve time.

Senator **Inouye**. Without objection, so ordered.

Mr. **Hannigan**. My final example of prometric bias concerns the decision to direct the report to the people in every walk of life. The development and content of any report depends basically on its purpose and to whom it is directed. Congress commissioned this study and asked very specific questions, and Congress was entitled to a competent, professional, and objective report that provided answers or stated some questions were impossible to answer.

The report, "A Metric America," does not fulfill its commission—it is not a technical report intended for experts such as are found on this committee and the House of Representatives Committee on Science and Astronautics. It does not answer the difficult problems or provide new information on the technicalities and complexities involved in metrication.

Senator INOUYE. In other words, it was not an elitist record.

Mr. HANNIGAN. It was not an elitist report, but it was done by——

Senator INOUYE. Done by experts to fulfill the needs of lay people. We were the ones who want to read it. I suppose a technical report wouldn't have made too much sense to us.

Mr. HANNIGAN. Not in the sense it is a technical report, but in the sense there was nothing new involved. The report contributed nothing new to the discussion or brought out the problems that I am bringing out right now of the impact on the industrialized economy, and the social problems. The report states some questions were difficult, so therefore they said, they wouldn't handle them. We will deal with what we can handle. But the extremely difficult ones necessary to determine, to develop any solutions on were ignored and are not even touched. These are the ones that will affect our country the most.

Senator INOUYE. What would your comment be on the suggestion that the European Economic Community has and intends to continue to provide artificial trade barriers based on standards involving metric units?

Mr. HANNIGAN. You have a bill S. 1798 that covers this area. We should negotiate, our negotiators should negotiate equal reciprocal trade agreements in the sense if other nations use nontariff barriers, we should penalize them. The mutual need of nations for each others markets will hopefully—cause them to relent on their use of nontariff barriers. We should negotiate with them to give up their nontariff barriers to advance free trade.

Senator INOUYE. Would you be against a national program to change the educational system to teach our youngsters the metric system?

Mr. HANNIGAN. That would depend upon the cost and the purpose. If we are not going to go metric, so as it affects the general population, it would be foolish to spend that money to train the people. If you train our younger generations and they don't use it on the day-to-day basis, as soon as they leave the classroom, they will lose it. The two are tied very closely together.

In short, if we are not going to be metric for quite a while, it could be a waste of money which could be used more effectively in other educational areas.

Senator INOUYE. For example, last year approximately 6 million Americans traveled abroad to countries using the metric system of measurement. I was in Mexico just a few weeks ago for 18 hours, and I must confess that I was a bit confused by liters since I am so accustomed to the gallon. I suppose the new generations will also be confused by the kilometer instead of miles. Don't you think a universal language of measurement might alleviate this problem?

Mr. Hannigan. I think a universal language would be ideal, but if we are talking about language, we are dealing with several hundred languages, and this world does exist and communicate.

Senator Inouye. At the present time we are the only major country that still insists on the imperial system of measurement.

Mr. Hannigan. Again I would have to point out that we are an industrialized economy which has a gross national product about one-half the size of the rest of the world and larger than the entire Western European countries.

If you wanted to use economic production as a measure of comparison, the U.S. share of the total world production, our system of measurement is almost equal to that of metrics. Not counting little countries. If you count every country in the United Nations——

Senator Inouye. The thrust of your argument is that we are well off now, leave it as is?

Mr. Hannigan. Not completely. We have to be aware of the increasing uses of the metrics and we have to minimize its impact on this country costwise, so therefore we would have to take a look at another—take another look at what the questions that were not looked at in this last report, and determine which is the best least-cost combination for us to adapt and manage this increasing use of the metric system.

It may be a longer period of time, I don't have the answer on that.

Senator Inouye. Maybe we could force the rest of the world to convert itself to our system.

Mr. Hannigan. It is a little too late for that, I think. Maybe right after world——

Senator Inouye. You are not suggesting that, are you?

Mr. Hannigan. No. It can accurately be described as a public relations effort to promote public support for metrication.

The enthusiasm of the National Bureau of Standards for forced metrication is not limited to the report. It has participated in a series of seminars called the "U.S.A. Goes Metric" and "Managing the Changeover." It also had a booth promoting metrication at the White House Conference on "The Industrial World Ahead, 1990."

We feel these promotional activities are premature since Congress has not taken any action on this matter, and that they should be immediately curtailed.

Third, we disagree with the recommended 10-year conversion period, because so little is known about its impact on our economy. Also, there are few identified benefits associated with conversion and no evidence of immediate need to warrant such an enormous undertaking.

Senator Inouye. Before proceeding, you have just made a statement that the Bureau of Standards had a booth promoting forced metrication——

Mr. Hannigan. A 10-year plan conversion period would be a forced—its proposal in the report, that is what I would call forced metrication, legally required.

Senator Inouye. I understand from the report we have had on this booth and the administration bill that the voluntary aspect is to be emphasized.

Mr. Hannigan. The bill is——

Senator Inouye. The bill is voluntary.

Mr. Hannigan. But not the report. The report would have to be mandatory because our discussion in the advisory panel, if it were voluntary, very few would convert.

So, ultimately, at some point, you would be more or less required to make it mandatory.

Senator Inouye. Are you in favor of voluntary conversion?

Mr. Hannigan. As has been discussed, I do not think a voluntary method would work.

Senator Inouye. The administration measure calls for voluntary conversion.

Mr. Hannigan. I have not seen that, but I do not think that really works.

Senator Inouye. Isn't it voluntary at the present time?

Mr. Hannigan. Yes, sir.

Senator Inouye. Is it working?

Mr. Hannigan. Well, let's define what we mean by work.

Work is converting to predominantly metric. The drift would be——

Senator Inouye. The pharmaceutical representative just testified that his industry undertook voluntary conversion, and it is just about fully converted.

Mr. Hannigan. Success of voluntary conversion would depend on to what extent the country would metricate.

Senator Inouye. All of the pharmacists have now converted though.

Mr. Hannigan Certain people would do it because it is economically advantageous.

Some would do it because it is convenient and are doing it without any compulsion.

They will continue to do it and there will be increasing use of it, but there will be masses of the people that will never convert and would never convert and you would hit this very unstable situation then where some of the people would do it voluntarily would be clashing at the people who are very reluctant to convert.

Senator Inouye. This matter does not require a big financial expenditure, but it affects every working man and woman in the United States. I have received communication from certain labor organizations objecting to the immigration of foreign workers. I will be very specific.

We have today in our country millions of foreign-made cars. Now, these cars were manufactured under metric measurements. So, a lot of the dealers ask these companies to apply for the entrance of German, Japanese, and French mechanics, but they need clearance from the Department of Labor as you are well aware.

In many cases, the Department of Labor has approved the application.

So, we have literally thousands of highly paid foreign mechanics in the United States because we have no Americans who can fill their shoes.

Mr. Hannigan. I think it is most unfortunate because we have 6-percent unemployment right now.

Senator Inouye. I agree with you.

Mr. Hannigan. Given training programs, I am sure American citizens can do this work.

Senator INOUYE. Exactly. Wouldn't you be in favor of an educational program?

Mr. HANNIGAN. Absolutely. Specific education programs would be essential, yes. But, of course, the details would have to be worked out. With the unemployment we have right now, the importing of foreign nationalities is just tragic.

Senator INOUYE. All right. We might have a conversion program where some of these young people in high school or vocational school would come out understanding the system.

Mr. HANNIGAN. I would have no objection to that, but that is a very specific program for a specific group, and I believe jobs must be assured. So many of our programs don't guarantee a job at the end of the training. But, if you are training a group of people to use metric tools and measurements and so on, I am sure there is a direct causal link between the training and employment at the end. I am sure we would support that very strongly.

Senator INOUYE. Please proceed, sir.

Mr. HANNIGAN. Third, we disagree with the recommended 10-year conversion period because so little is known about its impact on our economy. Also, there are few identified benefits associated with conversion and no evidence of an immediate need to warrant such an enormous undertaking.

For example, one of the primary goals of conversion is to strengthen our position in world trade, but conversion to the metric system would put the U.S. economy at a distinct trade disadvantage because the cost of conversion would have to be added to all U.S.-produced goods while foreign goods could take advantage of broadened markets, increased production, and lower production costs because of economies of scale.

The end result would be a massive influx of foreign goods into the U.S. markets and a loss of hundreds of thousands of U.S. jobs.

Also, foreign-made metric tools, instruments, and equipment in great demand by U.S. industries would flood the country. Plants made obsolescent by the forced conversion would very likely be rebuilt in foreign countries.

In short, instead of increasing exports, the conversion would increase imports and intensify existing balance of trade and payments problems, plus add to unemployment problems.

Senator INOUYE. Secretary Wakelin testified to the contrary. He suggested that it would increase our balance by at least $600 million.

Mr. HANNIGAN. I strongly disagree. I can't imagine how they could figure that. Our products just wouldn't be cheaper.

Senator INOUYE. Do you have any study that would support your conclusion that we would be flooded by foreign-made metric tools?

Mr. HANNIGAN. Just the very basic logic of additional cost imposed on our manufacturers and producers.

Senator INOUYE. Can't our toolmakers make metric tools?

Mr. HANNIGAN. Surely. But the cost of conversion would cost them money, the cost of retraining their work force would cost money. The cost of probably carrying dual inventories to service their market and foreign markets would require dual storage, dual financing; the whole economics of it just staggers the imagination. Metrication would increase tremendously the cost of production in this country.

Price is one of the key factors in competition in international trade. With us at a higher cost, it would be much more difficult for us to compete.

The study itself said the fact that we are not metric has little or nothing to do with our ability to compete. So how can the Secretary say that being metric would help us?

Senator **Inouye**. That is what I am asking you. I am not an expert.

Mr. **Hannigan**. This is one area that I am pointing out which has not been adequately studied. We should look again and find out the impact.

The study on international trade, as I mentioned earlier, ignored the transition period.

I can't quote the exact question, but it—assumed that we had made the conversion, when they were questioning the manufacturers. They came up $600 million, which is insignificant, compared to our total exports and the difficulties of predicting 5 years ahead. Then the conclusion was drawn——

Senator **Inouye**. This is, according to the Secretary, this is a per-year increase.

Mr. **Hannigan**. That is not what the study said, as I read the report on the international trade. The $600 million is the difference in 1975.

Senator **Inouye**. All right.

Mr. **Hannigan**. Because the respondents to the survey said it makes little difference whether they are metric or not. The key point is they ignored the transition period.

I am saying, let's look at this transition. What will happen between 1974 and 1984, when we are in this conversion period and our producers are experiencing this enormous costs and they already have the costs of pollution problems and other social obligations. It will just be a tremendous burden on manufacturers and producers in this country. Our concern is also with the jobs that would be lost because of it.

Senator **Inouye**. To the extent that there are capital costs associated with conversion, as you have suggested, is it not likely that industry in general will use this opportunity to upgrade the overall competitiveness of their product line?

Mr. **Hannigan**. I replied to that in the last sentence where I said many of these plants—I would visualize them as being a mature plant with a high maintenance requirement, and now they are required to install various metric equipment.

At that point, the decision would be whether or not to build a new plant. Where would it be built? The new plant would be built overseas so we would lose construction also. The direct investment overseas is just soaring fantastically over the past 15 years. It has become a very serious problem. This would hasten and increase the use of direct investment in foreign countries.

Senator **Inouye**. Should we take seriously the contention made by some in industry that the dual system has been a disadvantage to them competitively?

Mr. **Hannigan**. I am sure for some people it has been a disadvantage. I think under the present way we are doing things with some additional help to people particularly involved in the metric system, I think they could——

Senator **Inouye**. Should we provide subsidies for them?

Mr. Hannigan. I would be reluctant to go into detail on that. Unfortunately, subsidies can be abused. Again, that would be part of the study we are asking for in this testimony. Just how should we manage this? It is here, it is a problem that we have to face, and I think that would be a key part of the study.

Senator Inouye. I gather you are totally dissatisfied with the U.S. metric system?

Mr. Hannigan. Very much so. I don't think it meets the needs of our country right now as to answering the questions you need in preparing legislation for us.

Senator Inouye. Please proceed.

Mr. Hannigan. The conversion would have an adverse impact on the U.S. consumer. It would result in mass confusion and unfamiliar units. Prices would increase on U.S. products as manufacturers attempted to pass the cost of conversion to the consumer.

The consumer would become extremely cautious, and sales would be adversely affected.

There is also a strong possibility that the confused consumer would be easily cheated as a result of the approximation involved in a conversion from U.S. customary to the metric system.

Conversion would have an adverse impact on the income of workers on piecework or incentive systems, as a result of lower productivity due to the loss of experience.

In the construction industry, difficulties with maintaining dual inventories, controlling the schedule of deliveries to jobsites could result in extensive loss of time.

All workers will require additional training, the amounts and costs of which will vary with the degree of measurement of job content. Retraining the work force will cost both the contractors, management, and unions millions of dollars.

Many mechanics will have to purchase new tools; they will have to own two sets of tools and assume the burden of maintaining, storing, and transporting them.

Dual thinking will result in increased responsibility and job strain. Thousands of workers, especially older workers, some unable and some unwilling to learn, will either be faced with a greatly limited opportunity or forced out of the labor market.

Senator Inouye. Don't we have a dual system at the present time?

Mr. Hannigan. Yes; but in minimum use. I was sort of responsible for coordinating labor responses to this contract.

Senator Inouye. This is a small matter, but going back to the mechanics example again, don't they have two sets of tools—one to take care of Volkswagens, the other to take care of Fords?

Mr. Hannigan. Right now I was referring to the construction industry, and there is almost no use of metrication in the construction industry.

In Volkswagens and machine tools, I am sure there are, but in construction, I can't think of any application of the metrication. All our mechanics use inches and feet.

Senator Inouye. So you continue as is.

Mr. Hannigan. Yes. I don't see really much growth of metric usage unless it was required of the industry. If you let this industry convert voluntarily, this industry would be one of the very last to convert. It has got too much of a standing stock investment, the building we are in and the ones coming out of the ground will be with us for the next 75 to 100 years are being built in feet and inches.

The dual inventories involved in maintaining this building throughout a 50-year period would be a burden.

Most contractors have a minimum capitalization. Most have limited warehouse space. Now they would be bound to——

Senator INOUYE. Under the administration proposal, the construction industry could continue as is because conversion would be voluntary.

Mr. HANNIGAN. The construction industry never continues as is. Every building being built applies a different technique. It is a very dynamic industry.

Senator INOUYE. I am talking about the unit of measurement.

Mr. HANNIGAN. Unless it was required, I don't see any reason for them to convert.

We feel there is no legitimate reason to convert to metric measurement. International trade is not sufficient reason to warrant such social-economic disruption because it amounts to less than 5 percent of our GNP.

Forced metrication will not increase this Nation's productivity at all. In fact, it will be counterproductive and costly.

Thousands of small businesses not involved in foreign trade, unable to afford the cost of conversion and to obtain credit, would be forced to close. Thousands of others, unable to master technical complexities of conversion, would be forced out of business.

If, as mentioned before, conversion would have a severe impact on U.S. workers, especially the old, the young, and minorities, then conversion without provision to minimize injury would be disastrous.

Those consumers least able to learn and apply metric measurements in market transactions would be the most easily exploited by unscrupulous merchants and producers.

Again, it would be the old, the young, and the minorities who would be most likely to be the greatest losers.

Basic morality requires the Federal Government to establish adequate regulations to protect their interest.

To let the costs "lie where they fall" reflects an extraordinary degree of callousness and indicates total lack of thought behind the entire report.

The great tragedy in this philosophy is that in many cases, given Government assistance, much of the negative impact of conversion could be minimized, and, in some cases, avoided entirely.

It should be evident to most wise and sensitive people that prudent application of Government assistance would minimize and not increase the overall cost.

It is important to understand there is no cheap method of converting to the metric system. The cost of conversion will be so great that there is serious question whether our economy has the capacity to assimilate the severe dislocations, and whether the people will tolerate the social disruption associated with such a traumatic undertaking.

In view of the strong possibility of these undesirable consequences and the few benefits directly identified with the conversion, it would be foolish to rush into a 10-year conversion period.

The choice is not whether to plan or not to plan for increasing usage of the metric measurement, but to develop plans on sound, objective analysis.

The U.S. Department of Commerce U.S. metric study has failed to achieve this goal.

Therefore, additional study and evaluation of the problems associated with conversion to the metric system is desperately needed before any further action is taken.

We suggest Congress establish a new conversion study committee, independent of any agency of government, to conduct an inquiry into all phases of conversion to the metric system.

It is essential that such a study group have representatives of all sectors of our society, and the people already committed to use of the metric system be represented only in their proportion to the rest of society.

I want to thank you especially for the opportunity to present our views at this hearing.

Senator INOUYE. I thank you, Mr. Hannigan, for your participation in these hearings and your statement. I assure you it will be given our most serious consideration.

Mr. HANNIGAN. Thank you very much, Senator.

(The statement follows:)

STATEMENT OF THOMAS A. HANNIGAN, DIRECTOR OF RESEARCH AND EDUCATION, INTERNATIONAL BROTHERHOOD OF ELECTRICAL WORKERS

My name is Thomas Hannigan. I am director of research and education of the International Brotherhood of Electrical Workers, the world's oldest and largest electrical union, with a membership of almost a million, with 1,800 local unions in the United States and Canada.

As a result of my participation on the National Metric Advisory Panel and exposure to the problems associated with conversion to the metric system, we are strongly opposed to a ten-year planned conversion period. This position is based on our inability to identify any major advantages arising from conversion to the metric system and the glaring lack of information regarding its impact on a trillion dollar economy.

Several months back a Wall Street Journal article stated I was lonely with these views, but at the last meeting of the Advisory Panel I felt my views and criticisms had gained strength and were supported by many members of the Panel.

We have four major criticisms of the report—first, the U.S. Department of Commerce Report on the U.S. Metric Study is much too narrow; second, it is blatantly biased in favor of the conversion to the metric system; third, there is insufficient real evidence to support the recommendation for a ten-year coordinated national conversion program; and fourth, the recommendation to let the costs of conversion "lie where they fall" will impose extreme hardship on those individuals and organizations least able to afford them.

I will expand on each criticism in order—first, the study took too narrow a view. In spite of the obvious difficulties, a serious attempt should have been made to analyze the impact of metric conversion from a macroeconomic viewpoint as well as from a microeconomic viewpoint.

Conversion to the metric system must be analyzed in its proper perspective if we are to make sound decisions. The frequent analogy between the United Kingdom and the United States completely distorts the scope of this undertaking. It is like comparing a rock fall to an avalanche. On one hand, we have the U.S. with its one trillion dollar economy; on the other, we have the U.K. with an economy of little more than one hundred billion. Furthermore, in respect to the Common Market, the U.S. economy is two-thirds greater than the combined output of both the Common Market and the European Free Trade Association. The U.S.-U.K. analogy deteriorates further when one considers the types of national economies. The U.K. is an island nation whose very existence depends on international trade.

On the other hand, exports account for less than five per cent of the U.S. Gross National Product. Also, the desire of the U.K. for admission into the Common Market strongly influenced their decision to metricate.

In short, we are dealing with a gigantic economy in the U.S. and it is growing every day. Given full employment, it should reach 1.3 trillion in 1975 and 1.6 trillion in 1980. Therefore, any comparison of the U.S. economy to other national economies is grossly inappropriate and will inevitably result in disastrous decisions.

The U.S. Metric Study was limited to an industry by industry analysis, and, while most respondents indicated they will be able to adjust to the obvious costs and burdens of the metric system, little consideration has been given to the sum total of their respective impacts on our economy.

The following, I feel, is an accurate summary of most of the reports submitted to the Metric Study by industries and associations. In gneraly, they have very little present involvement with the metric system, have identified very few direct benefits, foresee many additional costs, but state a willingness and ability to make the conversion in the interest of the well-being of this nation. Unfortunately, no effort has been made to aggregate these costs and to estimate their total economic and social impact. Such folly is equivalent to rightfully assuming that a crowded theater can be emptied in an orderly fashion by two or three people passing through the exits over a sufficient period of time, but ignoring the panic and ensuing tragedy which results in an emergency when everyone at once rushes to the exits.

Now, imagine the U.S. economy in the fourth or fifth year of a ten-year planned conversion, the point of no return, being confronted with the economic conditions of the past three years. We have experienced soaring prices—up over 12 per cent in 36 months—increasing unemployment, tight money, a serious profit squeeze, corporate liquidity problems, an unplanned budget deficit, a decrease in industrial production and business activity, a painfully slow recovery, plus a 2 billion dollar Balance of Trade deficit—our first trade deficit since 1893. We now have a 6 per cent unemployment rate with no relief in sight; we are involved in an international monetary crisis, plus inequitable and unworkable wage and price controls. Add to these economic problems of the past three years the costs and dislocations associated with conversion to the metric system, and, instead of experiencing a period of economic stagnation, we would have experienced total economic chaos.

In brief, conversion can be accomplished only in a balanced, full employment, stable economy, which must be maintained throughout the entire conversion period. This best of all economic conditions has never been achieved for long and our present-day economic game planners seem unable to accomplish it even briefly. In a strained economy, the cost of conversion to the metric system would intensify the inflationary pressures; in a slack economy, it would impede and possibly preclude recovery. Thus, one of the principal limitations to conversion is our inability to successfully manage our economy through the extremely difficult conversion period.

This study gives little, or no consideration, to the impact of metrication on our social and cultural values. This is a most unfortunate oversight because today our society is in a continual state of flux. Our traditional values and priorities are being seriously questioned by all segments of society. I feel certain, given the enormous and urgent problems presently confronting this nation, the general public would assign a $60–$100 billion dollar conversion to the metric system the lowest priority. Without public support, metrication does not stand a chance. As the costs and disruptions grow with increased usage of the metric system, initial public reservations will rapidly become public rebellion.

We want to stress the need for an objective study to measure the intensity of the negative effects of conversion to the metric system on our nation. The negative effects of conversion include both economic cost and social cost. The impact of these costs is entirely different. The timing of the converson determines the intensity of each cost separately and of their combined impact on society. The longer the transition period, the lower the social disruption, but the higher the economic costs.

The attached Conversion Cost Curves are examples of the negative impact of an unplanned drift, a short term planned conversion period and a long term planned conversion period.

My second criticism concerns the pro-metric bias of the final report. This bias is found throughout the report in the techniques applied, semantics, sentence structure, and the subordinating of key issues—ignoring or subordinating negative findings and confusing editorial opinion with facts. No effort is made to distinguish the very few true benefits which are a direct causal consequence of conversion to the metric system from those which are merely possible indirect opportunities.

I also have serious reservations about the quality and objectivity of the technical reports. The most important observation of the entire study is found in the U.S. Metric Study Report on International Trade. It states, "The notion that the U.S. is losing exports to metric countries because its products are not designed and manufactured in metric units appears to be ill-founded." This finding is inadequately stressed and the report conveniently proceeds without sufficient reason or qualification to continue with unsupportable conclusions and predictions on international trade.

In each of these technical reports there is much evidence of a pro ten-year conversion period bias and many technical shortcoming and inadequacies are easily identified. Also, the study fails to adequately identify underlying assumptions and limitations of the technical reports. Some of the basic criticism of of the Advisory Panel, as I recall, were: The Standards Report tied success in establishing standards too closely to conversion to the metric system; the Education Report is principally an effort to promote educational reform; and, worst of all, the International Trade Report ignored the economic hardships and dislocations of the transition period. The study was based on the hypothetical situation that the U.S. had already converted to the metric system.

I also feel that the theme of the "informed" consensus, which is emphasized throughout the report, is severely abused. The report's statement that "over the course of study, almost every American had a chance to speak or be spoken for" is absolutely absurd. Public opinion polls indicate that most Americans are not even aware of the metric system. The fact is the U.S. public, business and labor have no real need for or desire to force metrication. The report ignores this finding and rationalizes that once the ignorance of the population is overcome through public education efforts, there will be universal support for the metric system.

Condescension of this type is all too characteristic of many supporters of the metric system. They obviously believe that they are the most qualified to decide what is beneficial for this nation. This elitist attitude discourages criticism and further thought and is most unfortunate, especially when so much remains unknown about this extremely important subject.

The entire labor section is misleading. The statement that part or all union members made at least some use of the metric system is completely meaningless since use lacks definition. Also, the statement that 40 per cent of the representatives were in favor of a planned national program is simply untrue. Most unions saw few direct advantages, but many disadvantages such as the cost of retraining, replacement of tools, loss of experience, loss of earnings, restricted promotional opportunities. Several major unions vehemently opposed conversion and consider it disastrous. Briefly, an accurate summary of labor's position was concern for the well-being of its members and the well-being of the country.

My final example of a pro-metric bias concerns the decision to direct the report to the people in "every walk of life." The development and content of any report depends basically on its purpose and to whom it is directed. Congress commissioned this study and asked very specific questions and Congress was entitled to a competent, professional and objective report that provided answers or stated that some questions were impossible to answer. The report, "A Metric America" does not fulfill its commission—it is not a technical report intended for experts such as are found on this Committee and the House of Representatives Committee on Science and Astronautics. It does not answer the difficult problems or provide new information on the technicalities and complexities involved in metrication—it is written for the general public. It can accurately be described as a public relations effort to promote public support for metrication.

The enthusiasm of the National Bureau of Standards for focced metrication is not limited to the report. It has participated in a series of seminars called the "U.S.A. Goes Metric" and "Managing the Changeover". It also had a booth promoting forced metrication at the White House Conference on the Industrial World Ahead, 1990. We feel these promotional activities are premature since Congress has not taken any action on this matter and that they should be immediately curtailed.

Third, we disagree with the recommended ten-year conversion period because so little is known about its impact on our economy. Also, there are few identified benefits associated with conversion and no evidence of an immediate need to warrant such an enormous undertaking.

For example, one of the primary goals of conversion is to strengthen our position in world trade, but conversion to the metric system would put the U.S. economy at a distinct trade disadvantage because the cost of conversion would have to be added to all U.S. produced goods while foreign countries could take advantage of broadened markets, increased production and lower production costs because of the economies of scale. The end result would be a massive influx of foreign goods into the U.S. markets and a loss of hundreds of thousands of U.S. jobs. Also, foreign-made metric tools, instruments and equipment in great demand by U.S. industries would flood the country. U.S. capital would be attracted by profitable direct foreign investments. Plants made obsolescent by the forced conversion would very likely be rebuilt in foreign countries. In short, instead of increasing exports, the conversion woud increase imports and intensify existing balance of trade and payments problems plus intensify unemployment problems.

The conversion would have an adverse impact on the U.S. consumer. It would result in mass confusion. Prices would increase on U.S. products as manufacturers attempted to pass the cost of conversion to the consumer. Consumers would become extremely cautious and sales would be adversely affected. There is also strong possibility that the confused consumer would be easily cheated as a result of the approximating involved in a conversion from U.S. customary to the metric system.

Conversion would have an adverse impact on the income of the workers on piece work or incentive systems as a result of lower productivity due to the loss of experience. In the construction industry, difficulties with maintaining dual inventories and controlling the schedule of deliveries to job sites could result in extensive losses of time. All workers will require additional training, the amounts and costs of which vary with the degree of measurement in the job content. Retraining the work force will cost both contractors and unions millions of dollars. Many mechanics will have to purchase new tools; they will have to own two sets of tools and assume the burden of maintaining, storing and transporting them. Dual thinking will result in increased responsibility and job strain. Thousands of workers, especially older workers, some unable and some unwilling to learn, will either be faced with greatly limited opportunities or forced out of the labor market. Conversion to the metric system would also tend to impede the entry of the young and disadvantaged in to the labor force. We feel there is no legitimate reason ot convert to metric measurement. International trade is not sufficient reason to warrant such social-economic disruption because it amounts to less than 5 per cent of our G.N.P. Forced metrication will not increase this nation's productivity at all. In fact, it will be counter productive and costly.

Thousands of small businesses not involved in foreign trade, unable to afford the costs of conversion and to obtain credit, would be forced to close. Thousands of others, unable to master the technical complexities of conversion, would also be forced out of business. If, as mentioned before, conversion would have a severe impact on U.S. workers, especially the old, the young and minorities, then conversion without provisions to minimize injury would be disastrous. Those consumers least able to learn and apply the metric measurement in market transactions would be the most easily exploited by unscrupulous merchants and producers. Again, it would be the old, the young and minorities who would most likely be the greatest losers. Basic morality requires the Federal Government to esablish adequate regulations to protect their interests.

To let the costs "lie where they fall" reflects an extraordinary degree of collousness and indicates the total lack of thought behind the entire report. The great tragedy in this philosophy is that in many cases, given government assistance, much of the negative impact of conversion could be minimized and, in some cases, avoided entirely. It should be evident to most wise and sensitive people that prudent application of government assistance would minimize and not increase the over all costs. It is important to understand there is no cheap method of converting to the metric system. The cost of conversion will be so great there is serious questions whether our economy has the capacity to assimilate the severe dislocations and whether the people will tolerate the social disurption associated with such a traumatc undertaking.

In view of the strong possibility of these undesirable consequences and the few benefits directly identified with conversion, it would be foolish to rush into a ten-year conversion period. The choice is not whether to plan or not to plan for the increasing usage of the metric measurement, but to develop plans based on sound, objecive analysis. The Department of Commerce U.S. Metric Study has failed to achieve this goal. Therefore, additional study and evaluation of the problems associated with conversion to the metric system is desperately needed before any further action is taken.

We suggest that Congress establish a new conversion study committee, independent of any agency of the government, to conduct an inquiry into all phases of conversion to the metric system. It is essential that such a study group have representatives of all sectors of our society and the people already committed to use of the metric system be represented only in their proportion to the rest of society.

I feel my very preliminary hypothesis warrants further investigation and development. A macro socio-economic model could be developed which would permit analysis through a wide range of variables. This method would provide additional insight into the scope of the problem and be the basis for a more enlightened decision.

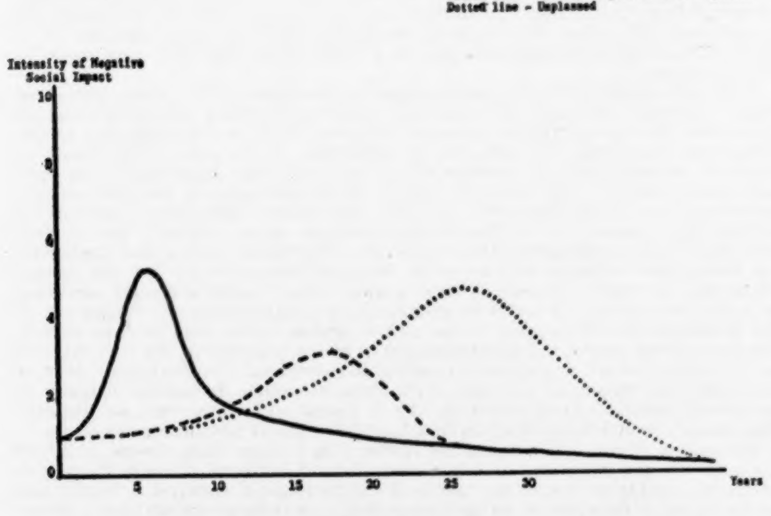


CHART SUMMARY

1. Unplanned drift—Summary: Second most disruptive of our society and most costly

1–20 years.—Increasing usage of metric system, but at a lower rate than the planned 30 years conversion.

20–25 years.—Negative effects become so great to warrant legislation establishing a mandatory conversion period.

25–? years.—Negative effective at a rate greater than 30 years planned conversion.

2. Short term planned conversion (10–15 years)—Summary: Most disruptive of our society and second most costly

0–5 years.—Increasing intensity.
5–10 years.—Decreasing intensity.
10–? years.—Negative effects will continue for generations.

3. Long term planned conversion (25–30 years)—Summary: Least disruptive of our society and least costly

0–5 years.—Additional study, preplanning, necessary government legislation.

5–10 years.—Planned and coordinated activities increase rate of usage and minimize the adverse impact.

10–20 years.— Monitor metric usage to determine if and when the voluntary phase of the metric transition plan should be replaced by a mandatory phase.

20–30 years.—Rapid decreases in negative effects because of substantial increase in usage in first 20 years.

30–? years.—Permanent negative effect same as 10 years conversion.

Senator INOUYE. This concludes our hearing, and because of the interest expressed in the metric conversion, the record will be held open for 2 weeks for the submission of additional statements.

I believe we all agree that eventually the United States will join the rest of the world in the use of the metric system as the primary or the predominant language of measurement; when, I do not know.

I think it is now the task of this committee to examine the record and the three metric proposals we have before us: One by the Congressman from Illinois, the other by the distinguished Senator from Rhode Island, and the final one from the administration.

I shall urge the committee to study the documentation presented. I shall further urge the committee to read the record and to take action, hopefully early action, on this very important matter to assure that this Nation, if it is to move toward a metric system, will do so smoothly. With this thought in mind and once again thanking all of you for your participation and for your patience, I adjourn these hearings.

(Whereupon, at 3:46 p.m., March 1, 1972, the hearing was adjourned.)

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

Steuben Society of America,
New York, N.Y.

Statement to the Members of the Senate by the Public Affairs Committee of the Steuben Society of America

Subject: Metric system.

The Steuben Society of America recommends the United States to adopt the Metric System.

We are the last of the industrial nations still utilizing the old units of measurement.

There are many instances metrical measurements are already being used as in Pharmaceutical, Photographic and Optometric industries. The National Aeronautics and Space Administration also uses the metric system.

Problems prevalent in international trade call for consideration for the changeover because the Nation's measurements are out of line with predominant world standards. This may well cause a tremendous loss in trade.

It is realized that the changeover must be done deliberately and carefully through a co-ordinated national program along with a program of education of the public.

J. George M. Stotz,
Legislative Activity Committee.
Edward J. Sussmann,
National Chairman.

Baltimore, Md.

Hon. **Warren Magnuson,**
Chairman, Senate Commerce Committee, Washington, D.C.

Sir: The time has come for the USA to join the other 99% of the world in the use of the metric system. Enclosed you will find two articles from a recent copy of Engineering News Record that support the Pell-Inouye bill now before your committee. I urge you and members of your committee to read them and take note of what they are attempting to say: that aside from being one of only half a dozen nations NOT using metric, that our international trade position would be enhanced. Further, scientists, engineers, and consumers would benefit from the change. If this Congress does not act affirmatively, the next will be under even more pressure to bring the USA into a position it should have assumed a hundred years ago. I urge your committee to support the Pell-Inouye bill, and to oppose the Administration bill. Thank you.

Yours very truly,

Burton Kleinberg,
Civil Engineer.

Enclosure:

IGNORING THE INEVITABLE

Having accepted the existence of People's Republic of China and its 800 million citizens, the Administration has demonstrated its ability to think about the unthinkable. Unfortunately, the White House has not been able to extend its mental resiliency to accept the metric system, which is used by about 3.5 billion persons.

The Administration has sponsored one of two metrication bills now before the Senate Commerce Committee (see p. 12) and it is so weak as to be almost not a bill. The Administration bill says, in effect: "Go ahead and switch to metric if you want, but don't expect the federal government to encourage it or to enforce it." The Administration bill would provide no timetable for conversion, no economic incentives to industry and no policing powers on behalf of metrication.

At a time when the U.S. suffers an adverse balance of payments, when the dollar is kicked about in the international money market, it is hard to imagine why the presidential advisors are so reluctant to make a change—an inevitable change—that would make it easier for U.S. industry to sell abroad.

The other metrication bill, submitted by Sens. Claiborne Pell (D-R.I.) and Daniel Inouye (D-Hawaii), would set a 10-year deadline for conversion, assign the government to police the process and sweeten the program with tax benefits and other financial aid. We think this is the better way to go about it.

All the other developed nations of the world and most of the undeveloped nations have either adopted metric or are in the process of doing so. For allies in what seems to be our national battle against metrication we have to look to such technological stalwarts as Zambia, Malaysia, Uganda and Sierra Leone.

THE SWITCH TO METRIC

Increasing interest in metric system seen in two Senate bills

Seven years after Great Britain created the machinery to start the switch to the metric system, legislative forces aimed at prodding the U.S. along the same route are getting up steam in Washington, D.C.

Two Senate bills, one from the Administration and the other cosponsored by Sen. Claiborne Pell (D-R.I.) and Sen. Daniel K. Inouye (D-Hawaii) are now before the Senate Commerce Committee. Two days of hearings last week suggest that a compromise between the bills may be reached by early spring.

The Administration's bill is the weaker of the two. Under it, the switch to metric would not be mandatory, there would be no incentives for conversion by large corporations, and industry would set its own timetable through an independent board.

The Pell-Inouye measure, on the other hand, would set a 10-year deadline for conversion, have the federal government police the process and provide special tax benefits and other financial aid to companies as needed.

The Office of Management and Budget, despite the Administration's claim that it is looking for ways to promote American technology to improve the balance of trade, opposes any federally supported schemes for modernizing equipment beyond existing tax credits and depreciation rules.

Apparently no one knows, and the recent Commerce Department $2.5-million study dealing with the possible conversion to the metric system (ENR 10/15/70 p. 16) didn't estimate, what it will cost U.S. industry to go metric. The British, now in the midst of a 10-year changeover period, never did make a detailed study of the costs, but in 1969 government officials estimated the switch would add from 3 to 4% to the cost of construction during each year of the change (ENR 1/16/69 p. 30). At that time, errors in design offices, manufacturing plants and materials distribution were expected to be the most costly.

In recent testimony before the Senate Commerce Committee, Frank Winters, assistant director of engineering for Caterpillar Tractor Co., Peoria, Ill., which announced production in metric dimensions of major components of newly designed diesel engines, said his company's U.S. plants are converting to the metric system.

LORAIN, OHIO, *January 8, 1972.*

Hon. ROBERT TAFT, JR.,
Washington, D.C.

DEAR SENATOR TAFT, I am quite concerned over the proposal, the U.S. change to the ***metric system.*** My concern is not only for the future cost, (tens if not hundreds of billions), but also the tremendous amount that has already been spent. I call your attention to page 8 Chap. 2 of Union Calendar No. 356, A Metric America. Under the heading "Inventing the meter," it is said the meter is strictly based on natural phenomena. I submit this is an untrue and misleading statement, unless one chooses to refer to a mistake as "natural phenomena".

The truth of the matter is, the meter ***was intended*** to be 1/10,000,000 of the distance from the equator to either pole. Subsequent careful measurement showed the actual distance to be 10,001,887 meters. Mr. Talleyrand goofed. The saying, a miss is as good as a mile holds true even in the metric system, because Mr. Talleyrands boner turned out to be 6,191.25 ft. or just a shade over 1 nautical mile (6,080.26 ft.). Therefore I am also concerned that we accept a measurement that is totally in error as a "standard".

I would sincerely like to be afforded an opportunity to appear before any body or committee holding hearings on the subject. I would therefore request your office inform me of the date of any scheduled hearings.

You are aware, no doubt, of groups or individuals who are opponents of the metric system. I would be very grateful if you would furnish me a list of these opponents so I can join forces.

I am convinced going metric will contribute to inflation. It will be of no benefit to the average American, and will cost him much more than he can afford.

Last, but by no means least, it would be un-American to go metric. We are, as you know, the worlds most powerful and advanced nation, and going metric or not cannot and will not alter this fact one iota.

Respectively,

THURMAN J. KELL.

THE UNIVERSITY OF WISCONSIN,
Waukesha, Wis., February 9, 1972.

Re Metric system.

Hon. WARREN MAGNUSON,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MAGNUSON: I thought you might be interested in the attached article that appeared in the February, 1972, issue of *Industrial Engineering.* I don't think you will find many people who have actually developed educational material on the metric system and who could talk about the reactions to educational talks by such different groups as members of engineering society chapters, craft unions, service clubs and management organizations.

If you think I can be of any assistance to you in this matter, please get in touch. I will gladly make myself available for congressional hearings or for committee or commission work.

For your information I also enclose some data on myself.

Sincerely,

HENRY KROEZE,
Chairman, Departments of Engineering.

Enclosures.

There is no doubt that the movement in the U.S. to change to the metric system will gain momentum, even if the government does not pass a metrication plan. IE's will be in the thick of it, so they should prepare for it now.

Henry Kroeze, University of Wisconsin Center System, Waukesha, Wisconsin

When 34-24-34 becomes 86-61-86

Some readers may still ask, "Is the metric system really going to come to the U.S.?" To answer this question, all one has to do is read the increasing number of articles in newspapers and magazines on this subject. Some industries, such as optical and pharmaceutical, adopted the metric system years ago, and more and more companies are embracing it. The new Ford-Pinto engine plant, which is being built in Lima, Ohio, will be completely metric. In order to survive, suppliers will have to follow suit. Recently NASA and the aerospace industry went metric. Scientists usually convert problems to metric terms before starting to explore solutions, especially in the fields of physics and chemistry.

Is there a voluntary push for changing to the metric system? It certainly looks like it. The Society of Automotive Engineers now requires that in all articles submitted for publication, dimensions given in our present "English" system (now abandoned by the English) be followed by metric system units in brackets, and drawings must be dual dimensioned, Reference 1. The new *Machinery's Handbook* (19th Edition) recognizes the worldwide move towards use of the "metric system international"; 273 pages of the 2,420-page volume contain metric units, formulas, and explanations, Reference 2. Several engineering and engineering-related societies have endorsed adoption of the metric system by the U.S. The fact that such companies as General Motors, Ford, Beloit Tool, Excello, Bendix, IBM, and others are cooperating with the Society of Manufacturing Engineers in the production of a video tape for showing on educational television could be interpreted as a gentle push for a change.

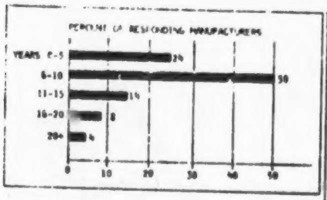
Many organizations are engaged in preparing their members for the switch. The American Management Association recently held a seminar, "Adapting to the Metric System: Managing the Changeover." The demand for speakers and instructors by unions, employers' associations, service clubs, technical societies, and institutions has increased tremendously over the last few months. This demand may be the result of the U.S. metric study reported to Congress in July 1971, Reference 3.

Why change?

In August 1968, Congress passed Public Law 90-472, which authorized the Secretary of Commerce to make a study to determine the advantages and disadvantages of increased use of the metric system in the United States. This "Metric Study Act" was the result of long-time efforts by Senator Claiborne Pell (Dem., Rhode Island) and Congressman George P. Miller (Dem., California), who were later joined by Senator Robert P. Griffin (Rep., Michigan). Its passage was certainly helped along when the English decided to go metric in 1965, and their former dominions started to follow suit during the next few years. At this time, over 90 percent of the world's population uses the metric system. As of November 1971, only the following countries are holding on to their own, or the old "English" system of measurement: Barbados, Gambia, Ghana, Liberia, Muscat and Oman, Sierra Leone, Southern Yemen, Tonga, Trinidad, and the United States.

The report to Congress was made in July of 1971, Reference 3. It is the result of a very thorough, unbiased study. Thousands of people from all walks of life were interviewed. The study was carried out by the National Bureau of Standards, with many groups participating (such as weights and measures groups, small business, trade associations, consumer education groups, state and local governments, farmers, federal civilian agencies, the Pentagon, professional societies [including AIIE], industries, home economists, labor unions, educators, and the international trade). The twelve volumes of data are condensed in the report to Congress. The report gives both the pros and cons of the metric system. This study clearly shows that the advantages of going metric far outweigh the disadvantages. Here are some of the results of the study:

- Manufacturers voted 70 percent yes when asked if increased metric usage would be in the best interest of the United States, and they are the people who have to pay the largest share of the bill. When those who voted yes were asked how the change should be accomplished, only 7 percent of them voted for no



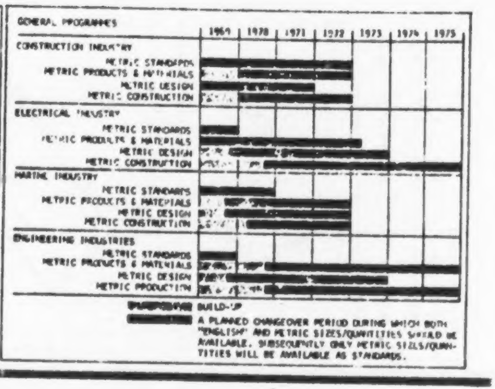


Figure 1. In a survey of manufacturing companies, half think the change to metric system should be programmed for a 6 10 year period. Nearly a quarter believe it could be accomplished in less time.

Figure 2. British timetable for industrial metrication.

program, 43 percent favored a mandatory coordinated national program, and 50 percent favored a voluntary coordinated national program.

- Non-manufacturing businesses answered the same question as follows: 6 percent don't know or no answer, 8 percent no program, 24 percent national voluntary program, and 62 percent national mandatory program.
- The majority in each group polled favored the metric system. Educators are nearly unanimous in their endorsement. A survey by the Survey Research Center of the University of Michigan showed that the general public knew very little about the metric system. However, those who were familiar with it, or knew something about it, favored it.

How long to change?

Figure 1 illustrates the various lengths of transition preferred by those that were polled in the manufacturing industry. Among the federal civilian agencies polled (894 responses were received from 55 agencies), 72 percent favored 10 years, while 23 percent preferred a shorter period, and 5 percent a longer period. Experiences in England have shown that 10 years is indeed a realistic choice for a transition period, Figure 2. Ten years would provide ample time to ensure a crisis-free conversion with a minimum of operating setbacks at a minimum cost.

Economic considerations

The government study shows that it will definitely be advantageous for our economy to switch to the metric system. There will be a loss of exports if we do not change. Several companies have come up with estimates of what it would cost them if no switch is made, Reference 4. It is estimated that the initial investments required for converting to metric will be recovered rather rapidly through our improved export position (better accessibility to foreign markets, which will improve our balance of payments) and savings through simplifications (eliminating costly errors). Some educators estimate that the educational process may gain 2 years when the metric system is adopted (no more fractions and no more hard-to-remember conversion factors between the different units of length, area, volume and weight).

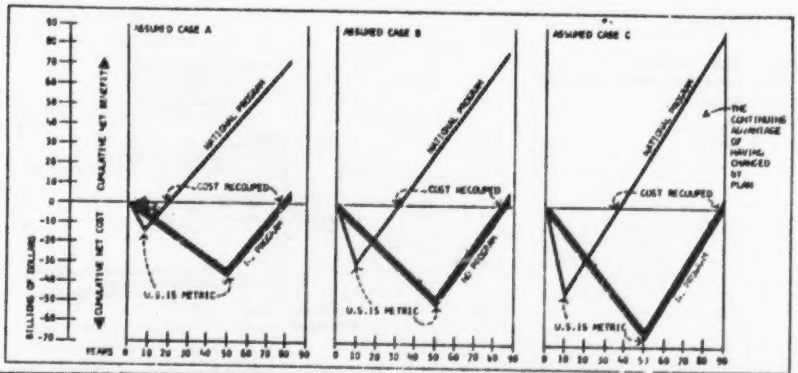
Figure 3 shows the economic advantage, for the manufacturing sector, of changing to metric by a plan. There are indications that if no plan is adopted, the United States will go metric anyway, but it would take 50 years before the changeover would be completed. After these 50 years, the recovery of losses and required investments will start, with total cost recouped after about 80 years, case A; and after 85 and 90 years for cases B and C. If the changeover is planned to take place over a 10-year period, the recouping will start after 10 years. It would be complete in 20, 30, and 37 years respectively. Case A assumes a total annual cost for the changeover period of $1.5 billion ($1.0 billion base cost and $0.5 billion dual capability). For cases B and C, these assumed annual costs are $3.0 billion ($2.5 billion + $0.5 billion) and $4.5 billion ($1.0 billion + $0.5 billion). The only differences between cases A, B, and C are the different base cost assumptions. Case A, for instance, assumes a total base cost of $10 billion. A later start of the changeover will result in a higher base cost.

From the report to Congress it may be concluded that:

1. The metric system is going to be introduced.
2. Most probably there will be a planned changeover.
3. The changeover time will probably be set at about 10 years.
4. Congress will probably approve a planned changeover to the metric system within the next 2 years.

Metric system and IE

From the previous conclusions, it would appear that the sooner your company starts planning for full-scale introduction to the metric system, the better. There are many areas where IE's will be involved — from the planning stage to long after the transition has been completed. A survey of the manufacturing industry gave the distribution of the estimated costs of changing to metric shown in Figure 4. Note that industrial engineers are in-



volved directly or indirectly with all the areas covered by the chart. Many companies may require extra help in their IE departments during the transition period. Several areas appear to require special attention by IE's.

Corporate planning

A plan must be established. Areas of change are to be identified. Even if the government would not take any action, a starting time for the changeover must be agreed upon and schedules set (both for equipment and products). This will give IE's the opportunity to plan for the elimination of obsolete equipment and methods. They will also have the chance to apply value engineering to parts and products. The changeover period will be an opportune time to develop savings by simplification of products and parts, and elimination of parts. Further, the costs of redimensioning parts and retooling will be reduced to the extent that parts are eliminated.

Training

It is natural for the IE department to take part in training programs. These training programs can be rather simple, but should be planned very carefully. The worst thing one could do is just give the production personnel a set of sheets with conversion factors and let them wrestle alone. This has been done and it creates a very hostile atmosphere. The best approach appears to be to arrange some training sessions that are designed to first eliminate the fear people may have for the metric system, which is something new and strange to them. Don't forget that it took time to learn to work in the English system, and many of the uninformed may think that the metric system is just as complicated. They don't want to go through another troublesome learning process.

The following training schedule has proved successful:

1. Explain what the metric system is — just another system of measuring with different base units. For visualization of the base units, compare them with the base units of the English system (a meter is approximately equal to a yard plus 10 percent, etc.). (Approximately 20 minutes)
2. Explain the use of prefixes (deci, centi, milli, etc.). (10 minutes)
3. Compare working in the metric system with working in the English system. (20 minutes)
4. Explain the temperature scales. (Optional) (10-15 minutes)
5. Discuss sample problems in both the English and metric systems, followed by a practice session. (30 minutes)
6. Show some educational aids (for self-instruction) for reading metric vernier calipers, micrometers, and dial indicators. (50 to 60 minutes)

It would be helpful to make these aids available so that a person can review them in private and progress at his own speed. These and other aids are available from several sources. (One source is Metric Consultants, 21720 West North Avenue, Brookfield, Wisconsin 53005.)

7. Explain the reasons behind the changeover to the metric system, a discussion of the report to Congress. (20-30 minutes)
8. Discuss aids available for getting used to working and thinking in metric (tables, etc.), Reference 5, and how to make your own conversion devices. (20-30 :minutes)
9. A question and answer period. (20-40 minutes)

The total program should not require more than 4 hours. Three 1½-hour periods, or two 2-hour periods, are much more effective than one 4-hour session. Also, plenty of handouts should be provided, such as References 5, 6, and 7.

AIIE chapters could provide a real service by holding local training sessions. However, it might be necessary to hold a few regional

Engineers Joint Council has established a Metric Panel to study conversion to the metric system. Frederick L. Taylor, a senior member, represents AIIE on this panel. He will welcome your commentaries on conversion. Please direct your correspondence to: Frederick L. Taylor, Department Chief, Room 425, Industrial Engineering Research, Western Electric Company, 225 Broadway, New York, New York 10007.

Figure 3. The economic advantage of changing to metric by plan. Case A assumes a total annual cost for the changeover period of $1.5 billion; Case B, $3.0 billion, and Case C, $4.5 billion.

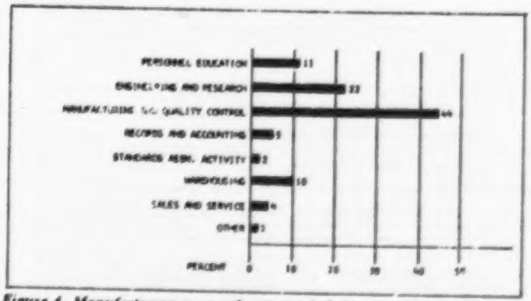


Figure 4. Manufacturers surveyed estimated their costs of changeover by categories shown, which were averaged. Manufacturing, quality control, engineering, and research account for two-thirds of the total.

seminars to prepare IE's to present such sessions.

Inventory control

During the transition period it will be necessary to have dual parts (non-metric and metric) inventories. The IE's should prepare for this, and may have to develop proposals for temporary increased space requirements. Also, they will probably be required to advise when to discontinue carrying non-metric parts, come up with plans and proposals for reduction of the number of parts to be kept in stock, and to establish inventory limits on the new metric parts. It will give them a once-in-a-lifetime opportunity to propose an economizing program that will offset costs incurred as a result of premature obsolescence of some tools, machinery, and parts.

Work measurement. Time units—hours, minutes, decimal hours — will not be affected. However, standard data related to English-system dimensions — e.g., a table of time standards for a cutting operation based on ranges of material thickness in inches — must be revised.

Probably the most difficult problem in work measurement will be met in the first stages of changeover. Operations involving measurement of parts or materials may be slowed until operators become accustomed to metric dimensions. Solutions will have to be found for these problems of temporary reductions in performances.

Facilities planning. Dimensions of buildings, bays, aisles, and all kinds of equipment and materials will change eventually. This means that plant and office layouts — including equipment and furniture — will have to be changed to metric dimensions. In fact, there may be a period of dual dimensioning.

IE's will be involved in many more areas of the changeover process, which will be different for each industry, and each company. They must be flexible, and will require continuous attention.

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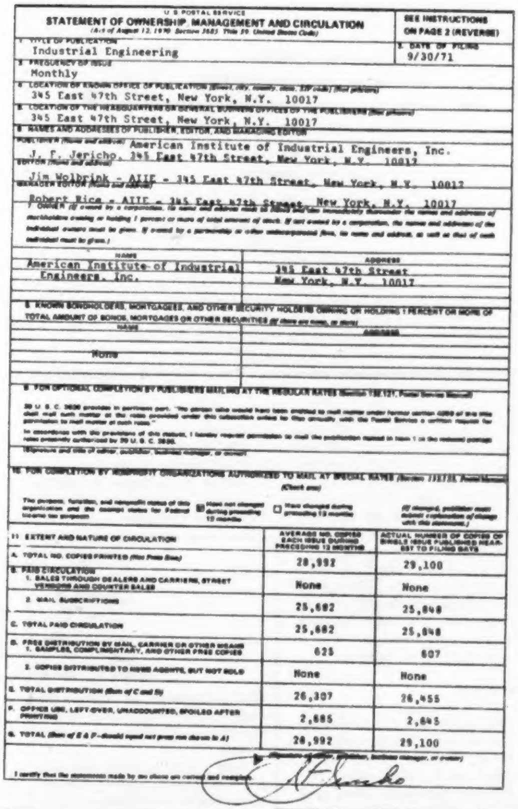
(6) *ASTM Standard Metric Practice Guide*, National Bureau of Standards Handbook 102, Washington, D.C., Superintendent of Documents, U.S. Government Printing Office, 1971 ($0.40).
(7) Machinery catalogs that include metric data, such as Beloit Tool Corporation and The Timken Company.

Henry Kroeze is Chairman of the Engineering Department of the University of Wisconsin Center System.

After several years in engineering and manufacturing management positions in industry, Mr. Kroeze joined the University as a Professor of Engineering. He was appointed to his present position in 1971.

Mr. Kroeze holds an Ir. degree in engineering (awarded after passing the doctoral examination) from the University of Delft, Netherlands. He is a registered professional engineer in Wisconsin.

An active senior member of AIIE, Mr. Kroeze is currently Chairman for Professional Development, Region XI. Also, he is a member of the Metric Association, NSPE, ASEE, and the Royal Institute of Engineers (Netherlands).



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FPO NEW YORK, N.Y., *February 22, 1972.*

Hon. WARREN G. MAGNUSON,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MAGNUSON: The Stars and Stripes newspaper recently ran an article quoting you as saying the Senate Commerce Committee would commence hearings February 29th to consider legislation that would put the United States on the metric system.

As Chairman of the Senate Commerce Committee I hope you will support the metric bill and encourage other Congressmen to do the same. The increasing international trading of the United States warrants our country abandoning the English system of weights and measures. The United States is the only major country still on the English system and there are only nine nations still on this archaic system.

After living in Germany for almost two years my family and I have seen through experience that the metric system is far superior in use and comprehension over our current English system.

Although converting to the metric system might not now be popular with most Americans it will, however, one day be popular with all our citizens who will be thankful to those who were instrumental in changing to the metric system.

Sincerely yours,

DONALD L. BURSON.

SOCIETY OF MANUFACTURING ENGINEERS,
Dearborn, Mich., February 23, 1972.

Subject: Senate Committee on Commerce Hearings on U.S. Conversion to a Metric System of Weights and Measures—February 29 and March 1—Senator Daniel K. Inouye (D-Hawaii) presiding.

Mr. HENRY LIPPEK,
Staff Counsel, Senate Committee on Commerce,
Old Senate Office Building, Washington, D.C.

DEAR MR. LIPPEK: As a result of our telephone conversation of yesterday, I am pleased to submit, for the hearing record, the following official policy of the Society of Manufacturing Engineers concerning the U.S. conversion to the metric system. Appearance before this Hearing Committee by representatives of the Society of Manufacturing Engineers, unless you would wish further clarification of this policy or our organization, would not cover any items substantially different from those contained in this letter.

This policy is as follows:

> "To serve the best interests of its membership and industry, the Society of Manufacturing Engineers endorses the use of the International Metric System of Units (SI)."
>
> It is the intent of this policy not to cause change of the established standards dimensions, tolerances, and specifications, but only to relate to conversion and use of the SI Units.

This policy was originally recommended by our Inspection and Quality Control Division, was approved by our Technical Council, and recommended to our Executive Committee and Board of Directors, who finally approved it as a matter of Society policy.

During the course of the last two years, the Society of Manufacturing Engineers has presented many major programs on the metric system for its members and for industry in general throughout the United States. Attached are several papers resulting from these programs, along with a sample brochure concerning the subject matter of the programs. As you can see from the attached brochure on the Society, we are a major professional Society of approximately 50,000 members who operate in all areas of the manufacturing spectrum and in all industries. The bulk of our members are concerned with the management decisions necessary to convert, along with the processing, tooling, and production problems which would be inherent in a conversion to the metric system.

Recently, the Society, in cooperation with the American National Standards Institute and General Motors Institute, produced an hour-long video tape entitled "Metric Orientation for U.S. Manufacturing Industry." This video tape has been made available to our 200 chapters, to other professional groups, and to industry in general. A list of the participants and their organizations, along with their subject matter on the tape, is attached for your information.

The Society is the sponsor of the American National Standard (B87 Decimal Inch) which has been in general use in industry.

Please let me hear from you if we can be of further assistance to your committee.

Sincerely,

BERNARD M. SALLOT,
Assistant General Manager.

INDIAN RIVER, MICH., *February 24, 1972.*

Mr. HENRY LIPPEK,
Old Senate Office Building,
Washington, D.C.

DEAR MR. LIPPEK: Unfortunately, I will be unable to attend the hearings and testimony regarding the National Metric Study and on Bill S. 2483 on Feb. 29 and Mar. 1, therefore I am taking the liberty as a private citizen, to pass to the committee my views on the subject in the form of a sample draft bill (attached).

I believe this draft represents the type bill that will be required to satisfy the varied requirements of the many segments of our society, including those that now believe the metric system has no place in the United States. Probably many of those will find that after five years of exposure their needs have changed.

I will appreciate your making this information a part of the records of the proceedings.

If at any time I could be of assistance to the committee please call me.

Sincerely,

WILLIAM K. BURTON,
Metric Consultant.

Enclosure:

SAMPLE DRAFT BY WILLIAM K. BURTON—METRIC CONSULTANT (FORMER MANAGER OF METRIC SYSTEMS DEVELOPMENT, FORD MOTOR CO., RETIRED)

Based on strong indications in the National Metric Study, undertaken pursuant to the Act approved Aug. 9, 1968, that it is in the best National interests, I recommend that Congress consider:

A bill to establish a program for the expansion of the understanding and the use of International Metric units of measure and increased participation in International Standards activities in and by the United States.

Sec. 1

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That there is established, under the general auspices of the Secretary of Commerce, the United States Metric Aid and Coordinating Commission (hereinafter referred to as the "Commission"). The Commission shall have nine members, to be appointed by the President, who shall represent (a) business, (b) labor, (c) education, (d) science, and (e) technology. Each member shall be compensated at a rate not to exceed $150 a day each day during which he is engaged in the business of the Commission and shall receive travel expenses while away from his home or regular place of business in the service of the Commission. Members of Congress or other Federal employees shall not be entitled to such compentation but shall be reimbursed for expenses incurred while in the service of the Commission. Each member shall have a five year term and may be reappointed by the President.

Sec. 2

The Commission is charged with the responsibility of establishing and implementing a plan to accomplish the broad objectives stated in the introductory paragraph of this bill including—

(1) That the United States expand the use of International Metric units of measure deliberately and carefully;

(2) That this be done through a national program established and coordinated by the Commission;

(3) That the Commission offer to and solicit from the various sectors and interests of the society aid and assistance to assure that the interests of all concerned are considered;

(4) That priority be given to educational programs to be carried out in the Nation's elementary and secondary schools and institutions of higher learning.

as well as with the public at large, designed to enable all Americans to think and work in metric units, to the extent that they now think and work in customary U.S. units of measure;

(5) That appropriate representatives of American enterprise participate in International Standards activities;

(6) That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that costs incurred in the use of metric units of measure will lie where they fall; extraordinary costs resulting from new National Standards that cause configuration changes (not proprietary) to comply with new International Standards in the manufacture of standard parts and materials (shelf items) shall be reviewed by the Commission or its Review Board before consideration of incentive recommendations; costs related to the development and implementation of educational programs shall be reviewed by the Commission or its Review Board before consideration of subsidy recommendations;

(7) The target date to achieve predominant usage of metric units of measure in the United States shall be delayed until after five full years of National preparation under the voluntary program of the Commission;

(8) That the Commission shall recommend and the Secretary of Commerce is authorized to provide through employment or contractual agreement the necessary expertise to assist and hold consultation with the Commission to assure the most sophisticated programs practicable to accomplish this most complex assignment;

Sec. 3

Each agency, entity, and authority of the Federal Government is authorized and directed to expand the use of the International Metric units of measure as soon as practicable and to cooperate fully with the Commission. Every effort shall be made to [illegible] undue pressure on the private sector where conflict over measurement unit usage is imminent.

Sec. 4

Five full years after the Presidential appointment of the Commission Congress will reconsider the necessity of further legislation to achieve predominant metric unit usage in this country and will be guided by conclusive and factual reports from the Commission during the next five years.

Sec. 5

The Commission shall transmit to the President and to each House of Congress annual progress reports beginning one year after the date of the complete Commission appointment.

Sec. 6

There are hereby authorized to be appropriated out of any money in the Treasury not otherwise appropriated such amounts as are required to carry out the provisions of this Act.

BURNS AND ROE, INC., *Oradell, N.J., February 25, 1972.*

Hon. WARREN G. MAGNUSON,
Senate Office Building,
Washington, D.C.

DEAR SENATOR MAGNUSON: I want to thank you again for your invitation to testify before the Committee on Commerce regarding S. 2483, the proposed metric conversion plan. Unfortunately, because of late-developing business commitments, I find that I will be unable to be present in Washington on the days in which the hearings will be held.

Burns and Roe, Inc., has been examining the impact of the metric system upon its operations and the industries that it serves. In my opinion the conversion of Burns and Roe's engineering and design work to the metric system can be accomplished with very little difficulty since the power, process and the environmental industries are using the metric system to some degree now. Chemical, electrical and nuclear engineers are trained in the metric system and use their weights and measures in nuclear reactor design, chemical process design, environmental process design and electrical equipment design. The civil and mechanical engineering fields are now starting to adapt codes and standards to the metric system.

The program of tax allowance for conversion in the machinery field is needed in order to accelerate the acceptance of the metric system. I also believe a similar program is badly needed in the construction industry where the training and education will be even more challenging because of the diverse educational backgrounds of the people in this industry.

I believe the ten-year schedule for the complete conversion to the metric system is reasonable and should be initiated immediately. There is obviously going to be increased costs associated with the conversion but it will also mean increased employment in some areas to accomplish the needed change. With the high unemployment at this time the implementation of the metric system conversion should generate badly needed work for technically-trained people.

Once again, I regret that I will be unable to testify regarding this matter; however, I hope my above thoughts are of interest to you.

Very truly yours,

Kenneth A. Roe.

Simpson, Gumpertz & Heger, Inc.,
Cambridge, Mass., February 28, 1972.

Re: U.S. Metric Study and Legislation (S. 2483).

Senator **Edward W. Brooke,**
John F. Kennedy Federal Building,
Boston, Mass.

Dear Senator Brooke: I understand that hearings will be held on 29 February and 1 March 1972 under the chairmanship of Senator Daniel K. Inouye, dealing with metric conversion.

I have nothing to gain professionally or financially from such a conversion to the metric (SI) system of measurements; but I feel that such conversion is vitally important to the United States. Some of the reasons are:

1. We badly need a more rational system of measurement to simplify elementary and advanced education, to simplify computations in commerce and industry, to avoid errors and misreadings, and to improve measurements in industry and engineering.
2. The United States should join the rest of the world in a unified system of dimensions, to improve its competitive position which is significantly weakened by merchandise made to non-metric standards.
3. The metric system is of great significance to consumers, as the simplified measures and conversion methods allow easier checking and comparing of merchandise.
4. Metric conversion will encourage general standardization of dimensions. This will be a tremendous help in reducing inventories and simplifying design of everything built in the United States. The construction industry will greatly benefit from the change, and costs may be reduced due to the lower capital investment required and the simplified measuring methods.
5. Metric conversion will improve communications with other countries especially in scientific and technical fields.

I support metric conversion as an engineer and citizen. I would appreciate your support of S. 2438 and associated legislation.

Sincerely yours,

Werner H. Gumpertz.

The Conference of Federal Environmental Engineers,
February 28, 1972.

Mr. **Henry Lippek,**
Staff Counsel,
Old Senate Office Building,
Washington, D.C.

Dear Mr. Lippek: Our Conference has learned that hearings are about to be held in connection with the proposed adoption of the Metric System of Measures in the United States.

Enclosed is a true copy of a Resolution on this subject that was passed unanimously by the Conference at its annual meeting that was held 19 November 1969.

We request that this Resolution be made a part of the record of the hearings.

Sincerely yours,

JAMES H. LE VAN,
Executive Director.

(Enclosure:)

RESOLUTION

The Conference of Federal Environmental Engineers hereby adopts the following resolution:

"The Congress of the United States is urged to follow an orderly, systematic program to implement immediately the adoption of the Metric System of Measures in the United States. A program should be implemented in well balanced stages to permit all American citizens to become gradually familiar with the new system. A ten year staging period should be developed during which a dual system should be used to enable everyone to become familiar with the Metric System in everyday life and industrial and commercial activities. The teaching of the Metric System to school children at all ages should be encouraged, beginning now. Each State should be encouraged and advised to enact legislation and procedures wherever necessary to conform to the National Policy.

"This program is considered by this organization to be essential to maintain the position of the United States in international trade and technical relationship. It is necessary for the continuing efficiency of the United States especially with regard to engineering and scientific affairs as related to commerce and industry with practically all foreign countries who have adopted or are in the process of adopting the Metric System."

Passed by unanimous vote, after discussion, at the annual meeting held 19 November 1969.

S. J. WARE, *President.*
JAMES H. LE VAN, *Secretary.*

A true copy.

COLLEGE PARK, MD., *February 28, 1972.*

Hon. WARREN G. MAGNUSON,
Chairman, Senate Commerce Committee,
U.S. Senate, Washington, D.C.

DEAR SENATOR MAGNUSON: The following statement, highly critical of the U.S. metric study and strongly opposed to legislation to convert this country to the metric system is submitted for your use as you deem appropriate.

The conclusion I reach on this vital issue, and the arguments supporting them are based on nearly 3 years of intensive investigations of the pros and cons, including 18 months with the NBS metric study team serving as consultant to the manufacturing industry and the NBS in developing surveys, analyzing data, and interacting with industrialists in these activities. I have written several articles on metric matters, including "A Midstream Look at the U.S. Metric Study" in the April 1970 issue of *The Magazine of Standards* and "What To Do When Metric Comes" in the December 1970 issue of *Professional Engineer.* I recently completed an unpublished paper "Small Business and the Metric System" as additional background material for the House Small Business Committee.

Most of the material in the enclosed "Statement" was drawn from a comprehensive article I am preparing for publication in the very near future.

Sincerely,

GEORGE C. LOVELL, I.E.,
Metric Conversion Consultant.

Enclosure.

Passage of Senate Bill 2483 at this time in our history could well prove to be a classic case of economic hari-kari. Most Congressmen, as with most citizens, are too preoccupied with other pressing national issues to be aware of what "going metric" really entails. The estimated price-tag of over $60 billion[1] could well exceed $100 billion when we include the large bureaucratic apparatus necessary to carry out any "coordinated national program" and the massive assistance which will be necessary to enable the many small businesses to adjust to the new climate; if indeed they manage to survive the dual impact of competitive disadvantage relative to the larger concerns and the flood of imports which such a national program would trigger (not to mention the million or more jobs lost to labor in the process!)

---

[1] A Department of Commerce estimate in a preliminary draft report but deleted in the final revision.

The metric system is a far superior system for the scientist and the chemist which explains why engineering and chemical sciences are taught in metric and why those industries closely aligned to scientific endeavor such as chemical, photographic, and pharmaceutical are on a metric base. But the metric system proves impractical for other sectors of our society when consideration is given to (1) the complete embodiment of the customary (inch, pound, gallon) system in our way of life, in our language and in our communication with one another; (2) the difficulty of converting a highly technical manufacturing society, with its interlocking structure of inch-based standard fabricated materials and components; (3) the virtual impossibility of divesting ourselves of the multitude of customary designed products woven into the fabric of our day-to-day lives, with the result that a dual system of non-interchangeable parts or components may be with us for 50 to 100 years or more, in turn requiring a bilingual measurement language during this entire period; (4) the possibility that 1 and 3 may lead to an outraged and resentful populace, necessitating forced abandonment of any "coordinated" government program mid-stream (with further disastrous economic consequence); (5) the uncertainty and unproven significant or tangible benefits which might accrue to any specific segment of society (with the exception of some multi-national concerns); and not least, (6) the spectre of a foreign trade deficit which would easily exceed $10 billion per year upon completion of the conversion program. . . .

These conclusions are the result of nearly three years intensive investigation of the pros and cons. "Let's Go Metric" is akin to the grass is greener syndrome which, one discovers as one wanders into it has potholes and deceptive patches of quicksand. The degree of support for converting this country to the metric system varies inversely to the degree to which the ramifications attendant to such a change are fully thought out. When first confronted with the hypothesis nearly everyone agrees it would be a good thing for the country. It is a nice innocent proposal and is in most people's list of 'good' things. After the question is asked and answered, most promptly forget about it. However, if the question leads to discussion, some doubts and reservations surface as to the practical difficulties of accomplishing such an undertaking. Then, if in-depth investigations are undertaken, a complete reversal in opinion occurs, not so much from the massiveness of the undertaking, but rather by bringing into focus the six basic points cited above.

FOREIGN TRADE

Congress had one overriding concern in authorizing the Department of Commerce to conduct a three-year study and that was an economic one; specifically, "Would a metric America pave the way for continued dominance in technology and total worldwide trade?" It is true that a one measurement based world would facilitate international trade by creating a worldwide interchangeability of parts and components. The question then arises "For whose benefit and at whose expense?" Before Congress opts for a metric America, it had better realize that the United States would lose heavily to other technological nations in the scramble for export markets, which, incidentally, includes a very nice slice of our own trillion dollar domestic economy. The notion that "going metric" would provide a panacea in foreign trade is a delusion which must be countered with reality.

We need but look to our neighbor Canada for a textbook illustration. Both countries produce to the same inch-based standards which, of course, facilitates foreign trade for those manufactured products which require precision interchangeability of parts and components. In 1964, the U.S. enjoyed a $700 million favorable balance of trade, $4.9 billion exported to Canada compared to $4.2 billion in imports. By 1969 the figures had expanded to $9.1 billion in export and $10.4 billion imports for a favorable Canadian trade balance of $1.3 billion. (In 1970, the Canadian advantage was even greater, over $30 billion.) The increased trade was in manufactured products, especially aircraft and automobiles. I fail to follow the logic which argues that if both countries were metric, the favorable balance of trade would revert to the United States. Yet in the face of this type of evidence, this fiction continues unchallenged.

During the Senate Commerce Committee hearings relating to metric conversion held in 1967, on page 54 of the November 15 report, for example, we read the following: "A recent study estimated that the United States is losing between $10 and $20 billion in foreign trade every year because she is not on the metric system."!! and the statement continues, "This export market would accrue to us as soon as we went metric!" This surely is a wild statement for if there is 10 or 20 billion dollars of business lying around—Where is that shrewd Yankee ingenuity and sharpness which could smell a buck a mile away? Well, a little detective work would have revealed that Yankee ingenuity had been at work. Yankee shrewdness had been on the trail, and Yankee know-how had persevered to the tune of almost 10 times that amount. And this was accomplished without a metric shot being fired although, unfortunately, this Yankee business did not accrue to our export account. I am referring, of course, to the multi-national company phenomena.

In 1958, while with the Business and Defense Services Administration (now Bureau of Domestic Commerce) I wrote a proposed position paper titled "Is the United States Pricing Itself Out of World Markets?" The gist of this paper presented the argument that instead of engaging in export trade it was more profitable in many cases to establish overseas manufacturing plants and capture that market on-site and at the same time export to other parts of the world (including the United States) from that location. Higher U.S. production costs made this possible and, I reasoned, if that trend continued, it would create a serious deficit in our foreign trade markets. (The paper was quietly buried as too touchy a political issue.) I claim no prescience for I never dreamed the extent to which this trend would mushroom some 12 years later.

The movement is natural under a profit motive economy. Companies which develop and produce a product keep gaining as the product finds wider and wider acceptance including export. As the technology becomes more widely available, foreign competitors get into the act. So, to hold on to their worldwide markets, in the face of tariff barriers, high transportation and high labor costs, the companies invest in plant abroad and these plants then look around for world markets.

Within the past three years, the multi-national phenomena has completely changed the world trade scenario and as a by-product scotches once-and-for-all the chestnut that if the United States converts to the metric system it will increase our export thereby enabling us to maintain a high favorable balance of trade. Consider the following facets of the new look: (1) The U.S. multi-national companies in the years 1969 through 1971 have more than doubled their overseas investment in foreign plant so that it now exceeds $100 billion; (2) The texture of that investment has changed, exceeding 50% in manufacturing plant compared to one-third in 1957; (3) The product of these overseas affiliates now exceeds $220 billion, of which half or over $100 billion represents products referred to as MSS (measurement standard sensitive), for a change in the measurement system would require changes in design and in the manufacturing process. *This product is now produced to inch based standards and due to the vagaries of history now provide insurance from calamitous inroads to our economy from metric standard based products.* To convert this capability to metric standards would destroy whatever technological superiority we have in MSS products.

Because these facilities produce to inch based standards over $1 billion a year in parts and components are exported from the U.S. Added ot this is nearly $2 billion in basic production machinery and equipment for new plant. In a metric world, the cost of this export would disappear for it would be cheaper to purchase from domestic sources which are already tooled up and producing to metric standards.

This type of observation holds for any MSS product whether or not produced by multi-national. For example, the interim metric study report titled *International Trade* on page 62 with respect to industrial fasteners noted, "If the U.S. adopts ISO (metric) standards for fasteners, its trade deficit will grow sharply because the competitive advantage will swing further to foreign producers who will have had production experience with most of these standards, whereas U.S. producers would have to acquire it." Other illustrations of this nature are legion but they are ignored and swept aside by those who, having but one objective, to "Let's Go Metric," do not want to be confused by the facts.

It is unfortunate indeed, that no in-depth study has been made about this vital issue. It is easy to make assumptions, develop a rationale and draw charts to show that our foreign trade deficit (less export and increased imports) would grow to $10 billion or even $20 billion yearly following any 10 year transition period. In making projections, only MSS products need to be considered.

Assume that by 1985 Congress has given the green light and the 10 year conversion period has been completed. According to the *International Trade* interim metric report MSS product export in the 5 year period 1965 through 1969 increased from $9.5 billion to $13.9 billion. Using that rate of growth, by 1985 under normal conditions a straight line projection shows that the increase would be about $14 billion for a total of about $28 billion per year. If half of this increase is lost because of loss of competitive technological advantage from metric conversion, we are out $7 billion a year. Added to this would be a portion of the current $14 billion. If we lost half of this (which includes the $3 billion to multinationals) we have another $7 billion for a total of $14 billion!

On the import side, a similar bleak picture is obvious. Using the same time frame, import of MSS product increased by $3.4 billion from $2.6 billion to $6.0 billion. At this rate, imports would grow to $16 billion by 1985. The extent to which this would be greater due to loss of technological superiority on the domestic front is anybody's guess. It could easily amount to another $8 billion a year. This total added to the $14 billion in reduced export indicates a swing of $22 billion a year by the time this country has completed its "coordinated" conversion program!

There is no question that figures of this magnitude can be attacked as unscientifically developed. Economists are always disagreeing with one another on specifics even though they may agree on generalities. There is no question, however, that the *direction* of import/export gyrations pursued here is correct. The assumptions and rationale leading to the $22 billion loss in foreign trade is much more sound than the rationale and assumptions employed to show that there would be a net *gain* of $1 billion a year in export trade, with no increase in imports as a result of metrication. What this proves is the desperate need, if Congress still has leanings to pursue the metric proposal, to first authorize an in-depth study by a prestigious economist who could look impassionately and objectively at the issue and would not bias the results for some self-serving objective. Unquestionably he would employ highly qualified economists and industrial technicians to come up with conclusions and recommendations which could bear scrutiny. Unfortunately, based on past history, they would not quell the debate. That can only be accomplished by shedding light on other complexities of the metric maze, mostly of a social nature, and debunking a number of metric myths which have been widely circulated.

SMALL BUSINESS IMPACT

The Manufacturing Sector.—For many manufactured products, the hardware[3] change would not be a significant factor for only the measurement language which describes it would need to be changed; e.g., screw drivers, novelties, furniture, and even complicated mechanisms produced solely for domestic use. Yet, at some point in time, as standard parts and materials are predominantly manufactured to metric standards every manufacturer who incorporates standard parts in his product will be faced with the hardware conversion. This would be the result of several factors; customer specification, higher cost of non-metric standard parts, and the scarcity of sources producing customary standard materials or components.

Any U.S. industry (inch based) that now has a worldwide competitive advantage (or domestic for that matter) because of technological superiority (thereby making it difficult or impractical to compete on a metric base) would find its competitive advantage scuttled if that industry had to convert. An example would be the U.S. oilfield equipment manufacturers who enjoy a viable worldwide market produced to inch-based standards. The software change which would occur as metric measurement language became universal would not affect their markets and it is inconceivable that they would voluntarily make the hardware conversion to metric-based standards. Yes, as sources of customary standard produced materials and components dried up, they would be forced to make the hardware change thereby opening the door to direct worldwide foreign competition.

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[3] A complete section in the basic series from which this paper was drawn details the difference between hardware and software conversion. Hardware means a physical change in size or configuration, whereas software refers to the translation of one system to the other; e.g., 2.54 centimeters in place of 1 inch.

Domestically, the technical aspects of hardware conversion alone would create practical difficulties notwithstanding any import implications. For some small businesses, this would be catastrophic, for some severe, and others moderate or trivial.

Commerce Secretary Stans in his report to the Congress recommended that any changeover costs shall "lie where they fall." The small manufacturer finding himself at a competitive disadvantage with the larger manufacturer may not agree with this recommendation, particularly since from his point of view, he is being forced to convert at no ostensible economic advantage to him.

Consider a small manufacturer of say less than 10 employees having one special production machine, or one each of several types of equipment. As metric production increases in the manufacturing sector, he will be receiving more and more inquiries or orders to produce to metric specifications, while at the same time, his inquiries or orders based on customary standards will be declining. How can he produce to both standards on the same machine? If he employs dual dimensions or dual read-out mechanisms on the equipment, what potential errors or reduced production capability would accrue by the necessity of his employees being forced to work under a bilingual measurement language?

In the December 1970 issue of *Professional Engineer* in an article titled "What To Do When Metric Comes," I described how products could be produced to both customary and metric standards in the same plant.—But this capability envisioned two assembly lines, one using the older inch-based equipment to produce the product to customary standards and dimensions, the other line using new metric designed or existing machines modified to produce to metric standards. The small concern has neither the flexibility, the facilities, nor the capital to do this. More significantly, some of the equipment may not lend itself to inexpensive adaptation to produce in both measurement languages.

The alternatives are not efficient solutions which places the small operator at a competitive disadvantage. The use of conversion charts opens the door to confusion, error, lost production time, and unhappy customers as those who have tried it well know. The small producer cannot afford the time and expense of dual dimension of drawings, nor can he expect the customers to furnish dual drawings. Even so, they also open the door to confusion and error, for such drawings have proved to be cluttered and difficult to read. The customer is more apt to turn to a supplier who can produce directly to metric standards or specifications. While this may create opportunities for larger concerns or entrepreneurs, it is no consolidation to the small concern suffering from loss of business.

These observations point up the need for an in-depth study by a technical or engineering oriented consulting firm. Such a study would also encompass the ancillary problems of (a) additional storage requirements which may be necessary because of dual stocks of material and parts, as well as dual inventories of finished products, (b) the extent of the need for new metric micrometers, verniers, depth gages, calipers, scales and the like, and (c) educational requirements.

Technical assistance for the small businessman would also be necessary. The negative as well as positive aspects should be included. Many people, unfamiliar with the ramifications of conversion might believe it is necessary to replace or scrap all machine tools. Any technical assistance should make clear just what the criteria are for determining what needs to be modified, what needs to be replaced, and what could be retained and used as is.

The Non-Manufacturing Sectors.—While the manufacturing community would be faced with the greatest burden, costwise, of any conversion program, there are several non-manufacturing sectors that would be faced with practical difficulties of varying degree of impact with the greatest impact falling on the smallest businesses. This fact and the possibility of serious repercussions with political implications if a premature metric conversion is attempted at the retail/consumer level provide the basis for my contention that such a program could be delayed for as long as 10 or 20 years after the manufacturing industry has metricated.

With respect to the practical difficulties, consider the small delicatessen or independent grocer. How does he convert his weighing devices concurrently with the large chain stores and what costs are there? Will the supplier of the replacement dials or drums on the scales have such replacements on hand on time? Who will pay for the Service and Installation? What scales need to be replaced or discarded because of the impracticability of converting or calibrating to the new units of gram or liter? What about pricing his stock which may be in pounds and quarts but which he now must sell by the kilo or liter—or conversely the new stock in kilos or liters commingled with pound/quart stock? The large concerns can phase these in or out at his central supply areas, but the small operator does not have such flexibility. All these potential problems need to be fully investigated and some form of assistance is indicated, particularly since the change stems from a government dictate rather than by a freedom of choice.

Service Industries.—There are two more categories of small businesses which may face serious problems in any national metric conversion plan: 1. Repair services; and 2. Parts suppliers.

1. For the small service or repair shop with limited resources, the problem of stocking a minimum number of popular parts in both metric and inch-based sizes would become intolerable, not only with respect to financing, but with respect to space. Then too, there is the problem of communicating with the consumer. When a housewife calls up and says "my washing machine stopped" and the repairman determines it is a certain part—does he take a metric or inch-based part for the service call? How does he communicate with the housewife to get the proper identifying model number to resolve the question?

Questions similar to the above are reviewed by Henry N. Ostberg of Sears, Roebuck and Co. in the interim U.S. Metric Study report titled "The Consumer." After looking at the magnitude of the problem, he estimated that the cost in additional metric tools alone for his company could represent an outlay of $2 million not to mention the cost of revising service manuals and other required educational materials. He then looks at the problems connected with repair parts inventory, internal company education and consumer education and concludes that even 20 years is not an unrealistic conversion period to permit an orderly control of repair parts inventory. He considers the external problem of communicating with the customer "a problem of far greater magnitude" for "there is no economic incentive for the customer to learn a new measurement language" he further anticipates "attitudes of apathy and even resentment" and concludes that "Above all, let's not be stampeded by a 'now is the time—let's go!' attitude."

Now Sears is a large organization and if they anticipate such problems with all their capabilities of organization and control to segment the difficulties, what about the small business man who has no such flexibility? Consider, a small garage mechanic; in addition to duplicate sets of wrenches, taps and dies, and so on, what about the aggravation and cost resulting from stripped threads, rounded nuts, broken keys and similar failures stemming from the incompatibility of the two fastener systems and the ease with which the wrong type can be selected in making a repair, not to mention the added inventory and difficulty of keeping that inventory from being comingled?

2. This latter observation leads us to the parts supplier most of whom are small businesses. Anyone who has had occasion to visit a parts supplier is aware of the multitude and variety of items in stock, not to mention the investment such stock represents. Now compound this situation with a duplicate counterpart of many of the items to metric specifications. Does he have the space? Can he afford it? What about inventory control and communicating with his clientele? This is really pertinent today with the increasing irresponsibility of hired help in delivering the correct size or model to the repair shop causing still further delay and costs, not to mention frayed tempers of all concerned; the repairman, the supplier, and the customer.

THE SOCIAL CHANGE

While the manufacturing sector of society would bear the brunt of the burden in cost, delay, and loss of business, the social change attendant to metric conversion will be much more difficult to bring about. The fact is well understood by those who would be on the firing line but is blithely played down by those deliberately attempting to give out the impression that there is public clamor to "go metric."

The element of *divesting* is the key. This principle is overlooked by those who have been abroad and laud the metric system for its simplicity when they return. They are correct in their conclusion based on their experience for they were in an environment completely oriented to metric language and products. There were no inch-based measurement phenomena all about them to block the mental adjustment to metric. The analogy to learning a foreign language is 'a propus' here for it has been recognized that one has to be immersed in the language environment in order to "learn" it and "think" in it. Their enthusiasm and urging to "go metric" would be in order if we could get rid of the inch-based ambience in which we live.

Illustrations are endless. The water meters and gas meters are in cubic feet. I agree that the solution to just not change them is the correct one but why embark on metric conversion in the first place if we intend to keep the old units anyway? A more awkward situation would develop in many other routine facets of our lives. Consider, the thermostatic controls in the millions of homes. Suppose the new or replacement thermostats have Celsius readings instead of Fahrenheit. It may take 50 years or more before the Fahrenheit style controls disappeared and all the while people will be forced to accommodate and use two systems of temperature readings instead of one. (There is also the practical problem of the necessity for half-degrees in the metric scale for one in degree is nearly 2 degrees in Fahrenheit, 1.8 to be exact. At 70° Fahrenheit equivalent to a one degree change in setting may be just right for the comfort desired, whereas a one degree Celsius might be too much.) The 9x12 rug, now 2.7x3.6 (meters) would still be there, as would the 8 foot high ceiling, a quart of milk would be .946 liters, a pound of butter 454 grams, and 176 miles between 2 cities would be 283 kilometers. Yet when one went to buy an 8 foot board, it would be a different length under metric standards. What size do you order? And of course, there is always the nut and bolts. Just what type do you buy so that the replacement will mesh with the old?

The point in all this is that none of these will just be discarded and their customary designation must be retained for many years. The pro metric enthusiasts shrug off these truths as mere temporary annoyances. They *know* the public will take them in stride. Well, they are not temporary and I'm not so sure the public will take them in stride. Inevitably, citizens will ask the question, "What am I gaining from all this?" "What's in it for me?" The flippant answer, "It's good for you" and "it's good for the country" and "besides its easier" just won't go over. The latter "it's easier" would be infuriating to anyone not familiar with metric units. Nothing is easier when it's new and strange.

The ease with which England converted to decimal currency from its awkward pound, shilling, pence system is frequently cited as evidence that metric switch-over would be a cinch. This conclusion is a delusion, because the principle of divesting was operable. It was a simple matter to take one's coins and bills to a bank on a certain day, get rid of it, and receive decimal currency in exchange. Since everyone else did the same thing, everyone was immediately in a decimal currency environment and within a day or so, everyone stopped grumbling about the new fangled money and began saying "Why didn't we do this years ago?" The same euphoria would not result in a metric change, for the 9x12 rugs, the electrical outlets, the myriad of inch based products would still be there.

This presence of inch-based objects explains also why children exposed to metric units in the school year after year never learn to "think" metric. As noted on page 34 of the metric study interim report "Education" the children come to think of the metric system as the one to use when they are doing science and the (inch) system as the one to use for all their other activities. For this reason, any premature massive educational effort would not be successful. Not until the inch based units can be dropped from our everyday transactions, can a truly metric oriented educational program succeed.

Another area of misunderstanding relates to the practicality of measurement units. The inch based customary system developed along practical lines. As certain units became obsolete, they were dropped. Mr. Blanton C. Wiggin, President of Advanced Instruments, Inc., has noted[3] that "Perches, pottles, poles, puncheons, peppercorns, palms, packs, pokes, and pennyweights have passed from the scene." To denigrate the system as full of 'barleycorn' is ridiculous. (Note: An inch at one time was defined as the length of "three barleycorns round and dry when laid together.") An inch is defined as exactly 2.54 centimeters and both can be made as accurate as instruments will allow. While the scientist in the laboratory may be ecstatic at the constancy of his dimensions, there being 9,192,631,770 cycles duration of Cesium 133 in one second, I think the run-of-the-mill citizen, the man or woman in the street is satisfied that there is 60 seconds in one minute, 60 minutes to the hour, and so on.

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[3] *Congressional Digest*, December 1971, "Should the United States Adopt the Metric System?—Pro & Con."

What is overlooked is the concept of measurement units as a set of tools, just as the mechanic has a variety of tools for specific purposes. The same is true for measurement units. When I drive [illegible]20 miles to New York City, I do not correlate the miles to its inch counterpart of 13.9×10^6 inches. I think of it as miles. I think of my dining room rug as 9×12 (feet) and am satisfied. Here again, illustrations are endless. To get rid of these tools for the sole reason that the new set has a decimal relationship doesn't add up, for the new set won't be used in normal living because of that relationship. Where a decimal relationship is desired in our current system, it is used. The decimalized inch is being used in shop drawings and as every housewife knows, the weighing scales at the market show the decimalized pound on the meat she purchases. And who is complaining?

On the other hand, the metric units have their flaws too. While the centimeter would certainly prove to be a useful day-to-day measurement tool in the home, there is no handy metric counterpart to the foot. The 30 centimeter ruler is within a quarter inch, and I suppose it would be given some easy name. The same problem exists for our gallon, there is no close metric unit of volume.

What this whole section boils down to is this. Will the man or woman in the street go along with the change? I believe that when the housewife, mechanic, trades people, service people, i.e., over 98% of the citizens, realize what the metric switch will mean to their routine way of life in the kitchen, the grocery store, department store, service shop, and the rest—a slow burn will develop which will grow in intensity when they realize they will be stuck with two systems of measurement for years upon years, and, more infuriating, it has been thrust upon them by a bureaucracy which seems to be insensitive to their feelings. After all, from their point of view, there is no apparent advantage and many obvious disadvantages—and the system is being forced on them. They haven't objected to the inch-pound system, they see nothing wrong with it, so why bother them with a change?

I would not want to be a politician facing millions of citizens with their hackles up clamoring for a reversal of any decision to metricate. Nor would I want to face the million or so laborers when they finally realize that their jobs have disappeared through the massive flood of imports as a result of the "coordinated national program."

A METRIC AMERICA?

The closing statements in the previous section remind me of one metric enthusiast who argued that we should at least try it and if it didn't work, we could always go back to the old system. This is the caliber of bureaucratic elitist who would be in charge of tampering with the most complex and sensitive of technological societies and willing to play Russian Roulette with our economy! The business community better wake up and take a good look at what is going on here before it is too late.

Following the submittal of the Final Metric Study Report and at the urging of my friends, I undertook to write a critique of that study, but I soon dropped that project for I concluded the study was too contrived. Now that the horses are at the starting gate and the signal to stampede is about to be given, I must speak out.

I agree with Mr. Hannigan, Director of Research and Development of the International Brotherhood of Electrical Workers that the study was unable "to identify any major advantages . . . and the glaring lack of information regarding its impact on a trillion dollar economy." [3] I have tried to fill in a few thoughts on that score. He also found the study "too narrow," I agree. "It is blatantly biased in favor of the conversion." This was no surprise, human nature being as it is. The NBS position was known when the study was placed there! "The recommendation to let the costs of conversion 'lie where they fall' will impose extreme hardship on those individual firms and organizations least able to afford them." True. Even before I had read his comments, I had submitted a paper to the House Small Business Committee describing this problem in some detail.

The best written part of the entire metric study was written by A. G. McNish on pages IX, through XXIV, PREFACE of the interim report "The Manufacturing Study" titled "Critique on Metrication Cost Estimates in Manufacturing." The critique is illuminating, thorough, and to the point. What is more illuminating is the fact that the critique was necessary in the first place, for the critique, in effect, is saying, "The cost study data are no good and should be discounted." I regret that my prediction came true that this would happen when a higher authority changed the groundrules midstream, but I am amazed that a Government agency would go on public record in this fashion!

The charts on pages 100–101 of the Final Report will undoubtedly become a landmark in deception and the rationale behind them a classic in obfuscation. They are strictly gossamer—lines based on unsubstantiated facts drawn to support a predetermined conclusion. Mr. William D. Rinehart of the American Newspaper Publishers Association Research Institute must have sensed this when he stated on page 303,[2] "The National Bureau of Standards has conducted a series of surveys to arrive at the statistics that are now being bantered about in an attempt to convince people that forced metric adoption is inevitable" and "The National Bureau of Standards chooses to ignore the facts in order to draw graphs to convince Congress that the American public, labor, and business are clamoring for forced metric." He really hit the mark with that shot!

The notion that going metric is inevitable as a reason for doing so needs to be examined. This prediction has been made for 200 years now, and it is as true (or untrue) now as it has been all along. I do not hold we should take the lead by following everybody else unless it is to our advantage to do so. Since it is not to our advantage, we should let nature take its course. After all, we became the world's mightiest technological nation and wil continue to be so if we stick with a winner. Even if it could be proven that going metric was inevitable, it would not justify the large bureaucratic empire which a "coordinated national program" would necessitate. (In fact, I am positive that is really what is behind the whole maneuver.) After all, death is inevitable and that certainly does not justify a "coordinated national program of genocide."

The decision to commit the NBS to the three year metric study has proved to be a great disservice to that prestigious organization. The NBS is the world's peer in matters relating to weights and measures and standards. It has a most talented cadre of physicists and scientists dedicated to that end. It is regrettable that a mere handful or perhaps only one person, not even of that breed, led the NBS into paths for which it was ill equipped and took advantage of the NBS inexperience to foster their own self-serving purposes through devious and questionable subterfuges which are now coming to the surface—with the unfortunate consequences that the NBS worldwide reputation has been sullied. The metric problem is primarily an industrial and social problem with the standards question but one, albeit vital, part of the total picture. If Congress should decide to pursue the matter further, it should place any responsibility for carrying out its mandate in a separate entity—whether it be a Commission, Agency, or whatever—and that entity would draw upon the recognized and established Government arms—Department of Defense for military, NBS for standards, and so forth—for the material it needs to accomplish its mission.

As for the basic question "A Metric America?" When the facts are in and evaluated, there could be but one conclusion, "This is a decision whose time has *not* come!"

Federal Products Corp.,
Providence, R.I., March 1, 1972.

Hon. Daniel K. Inouye,
U.S. Senate, Washington, D.C.

My Dear Senator Inouye: I am writing to you for the purpose of communicating to you my views and that of my company in the matter of the Metric conversion. I am aware that the Senate Committee on Commerce is holding hearings on Senator Pell's Bill on February 29 and March 1. I have previously written to Senator Pell giving him my views on the matter of metrication and what it will do in our opinion for both the country, and for the State of Rhode Island.

The highlights of my views as previously forwarded to Senator Pell are as follows.

1. The Metric changeover would require significant additional engineering talents which would put a large part of our unemployed technical skills back into production work.
2. Secondly, we should be able to utilize the changeover to modernize our methods and our equipment and enable us to be much more competitive in the world market place.
3. Thirdly, the obvious advantage of having a common technical language with foreign countries will enable us to assist in the development of good standards that will be beneficial in the long run to American manufacturers.

The approach employed in making the changeover will have a significant impact on how well its done as well as how effective it will be in solving our country's current structural unemployment problem in the field of engineering. Some form of Government reimbursement or financing of the changeover would go far towards speeding up the process and thereby making it more beneficial to our overall interest.

As a Rhode Islander I am deeply interested in this matter since a significant segment of our economy is dependent on machine tools and related inspection equipment and tooling. A Metric conversion would have a beneficial effect upon our economy in Rhode Island and surrounding areas, but more importantly we feel that the installation of new equipment and new techniques that would result from the engineering required to make the Metric conversion would be most beneficial to the total American economy, which economy is now facing quite severe competition in the world marketplace.

I appreciate the problems and complexities of any changeover and realize that the decision is a significant one. For that reason, I place before you my ardent plea that you recognize the significant advantages of Metric conversion and that you recommend support of Senator Pell's Bill.

Thank you for considering my views in this matter.

Sincerely,

JOHN J. KANE, *President.*

AMERICAN MEDICAL ASSOCIATION,
Chicago, Ill., March 2, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Committee on Commerce, U.S. Senate Office Building, Washington, D.C.

DEAR SENATOR MAGNUSON: We understand that your Committee on Commerce has just concluded hearings on S. 2483, the Metric Conversion Act of 1971. We would like to offer this statement of the views of the American Medical Association on the proposed national conversion to the metric system.

The American Medical Association has supported the adoption and use of the metric system for nearly 100 years; in 1878 our House of Delegates recommended the widespread use of the metric system by medical journals, in medical school teaching programs, and in hospital data recording and prescribing activities. This policy was subsequently reiterated by the Association many times thereafter and in 1896 we urged Congress to make the metric system the legal system of weights and measures in the United States.

Since then, there has been long and steady progress with increasing use of the metric system by the American medical profession, which has by now almost completely adopted a metric system of notation. The total conversion to the metric system by medicine must await a change in national policy so that the physician and patient may communicate in mutually understandable terms. Until the public learns and actively uses the metric system, the physician must continue to speak to his patient in the customary terms, for example, of temperature in degrees Fahrenheit, weight in pounds, and height in feet and inches. The public education program provided for in S. 2483 can be most effective in accomplishing this conversion to a single, universal, understandable, and rational system.

The International Metric System of Weights and Measures (the SI System) is recommended to Congress in the July, 1971, "Report to Congress—A Metric America" by the U.S. Metric Study, Bureau of Standards, Department of Labor as cited in S. 2483, Title I, Sec. 101(a)(1). The ten year conversion period provided for in S. 2483 and the recommendations outlined in the "Report to Congress—A Metric America", should provide ample opportunity to work out a practical and useful system of metric weights and measures, which will best serve the needs of all segments of American society.

Adoption of the metric system will improve scientific communication between physicians in America and those throughout the now almost totally metric world, and will have a most beneficial effect on the advancement of scientific medical care.

Sincerely yours,

ERNEST B. HOW[illegible]D, M.D.

HADDONFIELD, N.J., *March 7, 1972.*

Senator WARREN G. MAGNUSON,
Chairman, Senate Commerce Committee,
Senate Building, Washington, D.C.

DEAR SENATOR MAGNUSON: The attached two items are respectfully submitted for inclusion in the record of the Senate Commerce Committee hearings held on February 29 and March 1, 1972, on proposals to convert the nation to a metric system of weights and measures.

Item 1 is my personal statement which appeared in the December, 1971, issue of the "Congressional Digest" and in the December, 1971, issue of Standards Engineering." The latter is the Journal of the Standards Engineers Society. The comments are objective, uninhibited, and reflect many years of on-the-job observation and study in manufacturing, purchasing, and product engineering in American Industry.

Item 2 is a statement prepared by a number of my knowledgeable colleagues in American Industry. The text is designed to provide insights to the many factors that could lead to massive costs with no clearly identifiable benefits available in return. References are provided to substantiate the fact that there is much in the findings of the National Metric Study to support the idea that both customary and metric units should be encouraged in the United States; each for use where they serve best and none to be imposed where they have not gained acceptance, in free choice, on a need and merit basis.

It is my hope that both documents will help the Committee develop recommendations in keeping with the best interests of our nation. I have not considered it necessary to appear in person at the hearings, but I am at your service to provide any assistance you believe I might make.

Sincerely,

SAMUEL H. WATSON.

Enclosure.

INCREDIBLE WEAKNESSES IN THE CAUSE FOR METRIC

(By Samuel H. Watson)

Mr. Watson is a retired industrial executive, a leader in national and international standardization, and a member of the National Metric Advisory Panel

The July, 1971, recommendation to Congress by the Secretary of Commerce, "That the United States change to the International Metric System—through a coordinated program—and, at the end of a ten-year period, to be specified by the Congress, be predominantly, though not exclusively, metric," requires critical and searching examination. Convincing answers, or the lack of them, to questions posed in terms of the nation's best interests, can lead only to skepticism concerning the Secretary's proposal.

The reasons against a nationally programmed conversion to metric units of measure in the United States, and the abandonment of the well established customary units, are simple and of readily recognized merit, they are 1. A price-tag of one hundred billion dollars. 2. A period of at least 50 years of national controversy and confusion, and 3. Incredible weaknesses in the arguments of the advocates of metrication in support of the benefits they claim. A fourth consideration is the not remote possibility that a conversion program, if launched, would be abandoned before completion because of massive public indignation. On this point it is to be noted that, in England, major segments of that nation's metric conversion program have been dropped because of severe public pressure Strong public opposition to the entire British program still prevails.

The cost-estimate stated above may also be expressed as one hundred thousand million dollars. In either form it is staggering and difficult to comprehend. Metricators will probably claim it is entirely too high and those opposed to metrication will view it as conservative.

A dependable, real-life insight to metric cost is contained in the report of the Department of Defense, prepared by DOD as part of the 3-year metric study authorized by Congress. It is a comprehensive, fact-facing document authored by a large number of dedicated Americans who know their subject. To comply with a legislated or "nationally coordinated" program of conversion to metric units the Department of Defense alone will require *18 billion dollars.*

One large multi-billion-dollar electrical company, after careful study, reported a nominal 300 million dollars as its cost of converting to metric units; the cost would be higher if the program were confined to a ten-year period and lower if spread over 17 years. The several knowledgeable people who made the study figure that if, in the transition period, there were a dependable way of identifying and evaluating every expense that should be properly charged to the program, the actual, overall cost would be somewhere between 500 million and one billion dollars. Interestingly, another multi-billion-dollar electrical corporation of approximately one third the size reported a metric conversion cost of 100 million dollars.

The Department of Defense, although the largest, is only one of several thousand Federal, State and Local-level government agencies; and the electrical enterprises, although included in the hundred largest corporations of the nation, are only two of several million large, medium and small U.S. businesses. All are subject to extra-ordinary costs if a national metric conversion program were imposed. An estimated overall cost to the nation of one hundred billion dollars may be conservative. To justify an expenditure of this magnitude, and the additional billions required to service the debt entailed, would call for benefits and advantages of such gigantic proportions as to dwarf anything ever programmed for in United States history.

Metric units of measure have been around and available for more than a hundred and fifty years. During this period the United States has spearheaded the industrial revolution and has adopted every advantageous technique available to enhance its industrial drive and expansion. Metric units of measure have been examined time and time again as possible replacements for the well established customary units. Although they have always had some advocates in the sheltered environments of education and science they have never had enough going for them to impress the astute executives and statesmen who, through the years, have run United States industry and government on a real-life, cost-effectiveness basis. Nor have these leaders ever found any need to suppress the use of metric units. As a result, customary units and metric units serve in effective and compatible coexistence throughout the nation.

Metric units of measure, on a need and merit basis, have come into substantial use in certain sectors of the United States economy; the photographic film and pharmaceutical industries are examples. But in no area are they used exclusively. Each company and each industry, for its particular purposes known best to them, is free to use metric units where they are believed to be advantageous and customary units where they serve best. This democratic, free choice of units, depending upon application, is the secret of U.S. flexibility and success in measurement. Any attempts to sabotage the well oiled and smooth running machinery of U.S. measurement practice must be viewed with the greatest suspicion.

Not only in the United States, but world-wide, the measurement situation is highly satisfactory. There are only two sets of units recognized and used internationally; anyone who can use one intelligently can also use the other. Compare this with the world language situation wherein hundreds of languages and dialects are a real barrier to, and constantly compromise, international communications.

The false claim by metric enthusiasts that the United States is losing several billions of dollars in export trade to metric countries each year, because of failure to design and manufacture products in terms of metric units, was probably a major factor in pressing the Congress and the President to authorize the 3-year metric study in August of 1968. A National Industrial Conference Board report released later that year made it convincingly clear that units of measure are not included among the many considerations that influence U.S. export trade. Because of the untruths echoed by many irresponsibles concerning U.S. export trade, the U.S. Metric Study Interim Report on International Trade, issued by July 1971, looms as one of the most important products of the Study Program. The Summary of Findings of that document states, "The notion that the U.S. is losing exports to metric countries because its products are not designed and manufactured in metric units and standards appears to be ill-founded."

Another major claim or argument of the proponents of metric involves two separate and distinct things; one is the decimal relationships of many of the metric units of measure and the second is decimalization itself. Both seem to get confusingly combined in the telling, by enthusiastic metricators, and in the minds of many who have listened; a whole new world of easy arithmetic is thought to be opened up.

The opinions of a number of respected and distinguished individuals notwithstanding, neither the decimal relationships nor decimalization itself carry significant weight as influences in support of a change to existing measurement practices in the United States.

Decimalization is merely the practice of expressing values on a single line with a decimal point (.50) rather than as common fractions (½). Familiar examples are: 17.5 miles, $2.98 per pair, 10.6 gallons, etc. In actual present day practice the United States is second to none in the use and exploitation of decimalization; we see it all about us in everyday life. It is not a benefit to be realized—it is one long ago achieved.

The decimal relationships of metric units are briefly explained in terms of linear units. The meter (between 39 and 40 inches long) is the basic metric unit of length. Longer units are provided by multiplying, in steps, by ten; and shorter units by dividing, in steps, by ten. With each step there is a name for the resulting unit. For example, going from the meter to longer units; 10 meters equal 1 dekameter; 10 dekameters equal 1 hectometer; 10 hectometers equal 1 kilometer; etc. The meter and kilometer are familiar names and familiar distances to many; the dekameter and hectometer are strangers because they are seldom if ever used. In actual practice in metric countries the meter is multiplied by 1000 (10X10X10) and the direct result is the kilometer. This superfluity of units is a serious objection to the metric system for general measurement purposes in the United States.

The "ten times ten" relationship has fascinated and trapped the thinking of many. In the classroom many simple and interesting arithmetic manipulations can be performed. If you have a lot of meters, say 7800, you can convert to kilometers by adding a decimal point at the right hand end of the value, move it to the left 3 places, and the result is 7.8 kilometers. Conversely, to convert 7.8 kilometers to meters, move the decimal point three places to the right, add zeroes as required, drop the decimal point, and the result is 7800 meters. On the surface this seems to be a great thing, and to the extent it can be used, it is. But the question is, "who can use it to advantage—and how often?" For example, after an automobile trip of 156 miles, or other distance, who would feel impelled to determine how many feet or inches had been traveled?

Using the kilometer again as a key unit consider this hypothetical case: If, in a period of ten years, or more—or less, at a cost of untold millions of dollars in labor and materials, in all 50 States and Territories, miles were changed to kilometers for road and highway signs, speed limits, turnpike distance markers, laws and ordinances, automobile speedometers and odometers, and automobile guarantees and service instructions; and when, at long last the job is completed,—what will have been accomplished? This question has been posed to several individuals considered to have metric leanings; none has given much of a response. One weak reply suggested "Well, it would help people to think metric." Actually, it wouldn't even do that—people would become accustomed to a shorter mile, by a different name, with little awareness of any association back to shorter units. Just as with our established use of the mile—seldom are we concerned with how many feet or inches.

Metric enthusiasts attempt many arguments for metric units of measure. But like the examples above, they all have severe limitations and weaknesses. The great opportunity now available to the United States lies in the encouragement of the continued coexistence of customary and metric units. Metric units should be encouraged in any area where those concerned believe them to be advantageous. Our great wealth in the form of customary units, the associated instrumentation and documentation, and the expertise and knowhow of millions of our people should be safeguarded from all the irresponsibles who threaten it. This opportunity is available at no cost to the government in every sector of the economy. It requires only that the practice maintained or adopted in any sector pay its way or that all those involved are willing to carry the cost without imposing upon others. This course of action has much to recommend it; there is much in the findings of the recently completed National Metric Study to support it; the case for converting to metric units of measure and abandoning the well established customary units in the United States is incredibly weak.

GENERAL COMMENTARY

Cost: While considering Metric Study "Findings" and possible legislative action it is in context—and, in fact, vitally important to discuss cost . . . since cost and disruption are prime deterrents to metrication in areas where there is no incentive to change. For purposes of a brief overview, costs may be examined at the industry, company, and national levels.

In the official Metric Study document "The Manufacturing Industry" it is reported (NBS SP 345–4, page XIX) that ". . . the most thorough studies on the cost of metrication were conducted by companies engaged in the manufacture of transportation equipment, particularly automobiles and trucks. Reporting in industry 3711 are three companies, two of which are giants of the automotive industry of the world. We are well acquainted professionally with those responsible for submitting the reports and conducting the investigations . . . we have a high degree of confidence in the estimates . . . we deduce that the cost of metrication in the passenger car automobile industry over the period of transition would be about 6 percent of value added. If this cost is spread evenly over a period of 12 years . . . and if the percentage added cost of metrication of suppliers to the automobile manufacturers is about the same as that of the manufacturers themselves, the *cost* of metrication borne by the consumer would be about ½ of one percent of sales value, that is about $15 on a $3000 automobile. It seems that these cost estimates, which are based upon very serious studies . . . represent a realistic estimate of the cost involved in a fairly complicated product such as automobiles which account for a very large part of the gross national product . . ."

Having set these official, documented cost estimates up in our minds, we now may ask: "What, then, would be the 'price tag' on a 'metric car'?" . . . and we can estimate that it would cost the American public on the order of $1.5 billion. (This figure is obtained by applying the $15/car estimate, over a 12-year period, assuming average price of at least $300.)

For *Manufacturing Industry* as a whole, the final Metric Study report (NBS SP 345, page 110) says . . . the total overall 'Base' cost of going metric was calculated to about *$25 billion.*"

For some *indivdual companies,* the cost of forced metrication clearly would be on the order of some hundreds of millions of dollars. For example: in *Congressional Digest* magazine, Dec. 1971 issue, page 307, Mr. S. H. Watson said: "One large multi-billion-dollar electrical company, after careful study, reported a nominal 300 million dollars as its cost of converting to metric units; the cost would be higher if the program were confined to a ten-year period and lower if spread over 17 years. The several knowledgeable people who made the study figured that if, in the transition period, there were a dependable way of identifying and evaluating every expense that should be properly charged to the program, the actual, overall cost would be somewhere between 500 million and one billion dollars. Interestingly, another multi-billion-dollar electrical corporation of approximately one third the size reported a metric conversion cost of $100 million dollars."

In regard to the total cost of metrication for the *nation*: adding costs estimated by various sectors, figures in the final Metric Study report (NBS SP 345) indicate that the total United States cost would be substantially more than *$45 billion.* In the *Congressional Digest,* Dec. 1971, page 305. Mr. W. D. Rinehart (Nat'l Metric Advisory Panel, NMAP) said: ". . . during the study the National Bureau of Standards reported to the non-government panel that the cost of national conversion would be *$60 billion* . . ." And, on page 307 of the same *Congressional Digest* issue, another NMAP member, Mr. S. H. Watson, places the cost of U.S. national metric conversion at *$100 billion.*

Clearly, there is no one generally accepted figure for the potential cost of United States metrication. However, whether the correct number is $45 billion . . . or $60 billion . . . or $100 billion . . . it is an enormous amount of money.

In considering "the U.S. metric question." Congress will take the overall cost into account—and also consider that a crash program of forced metrication would be a long and difficult process . . . characterized by widespread disruption and confusion—since national metrication, ultimately, would touch the everyday lives of all Americans and would affect products and operations of every business.

Other 'Findings":—In a straightforward manner and with truly constructive intent to assist Congress in viewing pertinent information—we should like to take note of some material that would seem to indicate that, in the United

States, Industry, Busines, Labor, and the Public, generally have no need or desire to initiate full-scale metric conversion programs—and that the Department of Defense would have grave difficulty in fulfilling its responsibility while a national metrication program was being implemented.

Let's turn, now, to some of the *official documents* in the 13-volume series of reports on the Metric Study.

Following are some key quotations:

International Standards Report (NBS SP 345–1):

"SI (metric) usage in international standards as a measurement language does not of itself pose any serious complications to the U.S. . . ."

Federal Government: Civilian Agencies Report (NBS SP 345–2):

". . . there would be certain added costs of operation imposed on Federal agencies by the conversion effort. Even with conversion of measurement units alone, employees already on duty would have to be trained and the general populace familiarized with the new system, measuring instruments converted or replaced, publications revised, legislation involving specified weights or measure amended and some computer programs (e.g., air traffic control) rewritten. With conversion also of engineering standards to a rational SI base, there would be additional expenses for extra standards-developing activity, and for maintaining a degree of dual inventory or parts as long as customary-engineered equipment remains in use."

Commercial Weights and Measures Report (NBS SP 345–3):

"Purpose is to . . . analyze the problems that increased metric usage would have on state and local weights and measures jurisdictions (e.g., laws and regulations, testing equipment, and training programs)." . . . "Evidence indicates that evolutionary metrication in the commercial weights and measures area is unlikely . . ."

The Manufacturing Industry Report (NBS SP 345–4):

". . . under a coordinated national conversion program, present non-metric users generally saw more . . . disadvantages than advantages . . . more companies . . . are against increased metric use in their own industries than for it . . ."

Non-Manufacturing Businesses Report (NBS SP 345–5):

"The vast majority of companies saw no reason to change their system of measurement unless the whole U.S. does . . . they had no intention of increasing their own metric use without the rest of at least their own industry."

Education Report (NBS SP 345–6):

"The chief inherent educational advantage of the customary inch-pound system is its familiarity and the fact that it is embedded in a thousand years post-Anglo-Saxon culture. Other educational advantages become apparent whe the customary system is compared with the metric system . . . metric units are either too large or too small for very young children to handle easily . . . the inservice (metric) training of a million elementary school teachers is a major concern . . ."

The Consumer Report (NBS SP 345–7):

". . . a majority of consumers are satisfied with the customary inch-pound system . . . they know very little about the metric system . . . and they could be expected to react with apathy and indifference to any planned conversion program . . . a majority of respondents were unable to name a single metric measure . . . the consumer is little affected by increasing worldwide use of the metric system . . ."

International Trade Report (NBS SP 345–8):

"The notion that the U.S. is losing exports to metric countries because its products are not designed and manufactured in metric units and standards appears to be ill-founded . . . U.S. exporters and importers rank the measurement factor very low, indicating it affects trade only slightly . . . exports of most product classes in 1975 would change little by converting to the metric system. . . ."

Department of Defense Report (*NBS SP 345–9*) :

"If conversion to the metric system is directed, the DOD transition will have a significant impact on mission capability unless sufficient additional resources are made available . . . total additional funds for transit to DOD use of the metric system are . . . $18 billion . . . and cannot be absorbed within DOD budget without deterioration of the military posture . . . there will be no major advantages . . . and major disadvantages will occur . . . conversion of the country to the metric system could adversely impact on ability of the United States to support its military forces during the proposed transition period . . . no inflation factor was applied (to $18 billion cost) . . . cost estimate does not include increased cost of 'off-the-shelf' type metric items . . . cost of mistakes by operating personnel due to 'metric mix-ups' was not estimated . . ."

A History of the Metric System Controversy in the United States (*NBS SP 345–10*) :

". . . Almost two centuries of debate have attended the metric question in this country. Thomas Jefferson and John Quincy Adams were embroiled in this controversy. It has yet to be resolved, (Mr. D. V. De Simone, 1971) . . . the substitution of an entire new system of weights and measures, instead of one long established and in general use, is one of the most arduous exercises of legislative authority (President John Quincy Adams, 1821) . . ."

Engineering Standards Report (*NBS SP 345–11*) :

". . . it is the engineering practice rather than the measurement units that determines compatibility or incompatibility of most standards . . . dimensional specifications in different metric countries are incompatible as frequently as those in countries using the inch unit . . . thus a change to metric units does not by itself make standards compatible."

Testimony of Nationally Representative Groups (*NBS SP 435–12*) :

". . . Trade associations, labor unions, professional societies, and other groups were invited to submit their opinions and cost-benefit estimates concerning a possible future conversion to the metric system on behalf of their membership to the U.S. Metric Study.

. . . Many contributions report little significant usage of metric units, but two-thirds of the reports indicate some metric usage, usually in research-related activities.

. . . Transition problems appear significant in three areas: where metrication would require substantial redesign, modification or replacement of manufacturing equipment and manufactured products; where additional stocks of materials and repair parts would be needed; and in consumer education."

A Metric America: A decision whose time has come (*NBS SP 345*)

Refer to "Benefits & Costs: (*begin page 97*) :

Manufacturing industries	$25 billion.
Nonmanufacturing businesses	?
Weights and measures	340 million.
Federal civilian agencies	600 million.
Department of Defense	18 billion
Labor	?
Education	1 billion.
Total: at least	$45 billion.

"The cost and inconvenience of a change to metric will be substantial, even if it is done carefully by plan . . ."

Also worthy of note are the following statements by various National Metric Advisory Panel members in articles published in December, 1971, issue, *Congressional Digest* magazine:

"I am strongly opposed to a ten-year planned conversion period. This position is based on our inability to identify any major advantages arising from conversion to the metric system and the glaring lack of information regarding its impact on a trillion dollar economy."

. . . T. A. Hannigan, Director of Research & Education, International Brotherhood of Electrical Workers.

"The (Metric Study) findings, if carefully examined, will reveal that the U.S. public, business, and labor have no real desire to force metrication. . . . The American consumer would feel the cost of price increases on American products as manufacturers attempt to pass along their cost of converting every machine and employee to the metric measure. . . . It is my sincere belief that a 'forced metrication' law would have detrimental results upon the American economy and the American public."

. . . W. D. Rinehart, Ass't General Manager, American Newspaper Publishers Association Research Institute.

"The reasons against a nationally programmed conversion to metric units of measure in the United States, and the abandonment of the well established customary units, are simple and of readily recognized merit. They are: (1) a price-tag of one hundred billion dollars. (2) a period of at least 50 years of national controversy and confusion, and (3) incredible weaknesses in the arguments of the advocates of metrication in support of the benefits they claim. A fourth consideration is the not remote possibility that a conversion program, if launched, would be abandoned before completion because of massive public indignation."

In the judgment of Congress, it is imperative, in the long-term national interest, to adopt the metric measurement system? If so, let's face-up to it openly and honestly. If, overall, the country's long-term economic well-being requires that we now enter a long period of personal inconvenience and expense to many millions of Americans and disruption and financial penalties to many thousands of businesses—then let's put it frankly in those terms. Surely, we all can—with understanding and support—accept a situation where the Nation's long-term interests transcend a multitude of individual interests.

But, if that is the case with respect to the U.S. impelling need for metric conversion—let us not begin a long exercise in self-deception. Let's neither exaggerate the urgency and potential benefits, nor deprecate the difficulty and cost.

In this regard, let us have no illusion about the reference to "voluntary" metrication. If a national program, backed by Federal law, progresses in conformance with a mandated timetable—it is not really voluntary. And, if it is truly voluntary—it won't occur nationwide during the next 10–15 years.

We fully recognize that the U.S. Congress will decide this question. Congress will decide where metrication ranks among national priorities: And, in its broad allocation of national resources, Congress will determine what portion is to be directed into metrication. Congress will judge whether or not the Nation's need for metric conversion is so vital and so urgent as to warrant diverting the country's energies into this channel—and on a scale that may call for the expenditure of from $45 billion to $100 billion over a 10-year period.

THE SOCIETY OF THE PLASTICS INDUSTRY, INC.,
New York, N.Y., March 7, 1972.

Mr. HENRY LIPPEK,
Staff Counsel, Senate Committee on Commerce,
Old Senate Office Building, Washington, D.C.

DEAR MR. LIPPEK: The release regarding your February 29th and March 1st hearings on proposals to convert the nation to a metric system of weights and measures came to my attention on March 3rd.

I am enclosing a copy of a resolution passed by the Board of Directors of the Society of the Plastics Industry, Inc. at their meeting of February 18.

If you believe we can be of help in any way I hope you will let us know. If you have information that you believe might be of interest to us on this subject, we would appreciate receiving it.

Sincerely,

G. R. MUNGER, *General Manager.*

Enclosure.

RESOLUTION PASSED BY THE BOARD OF DIRECTORS OF THE SOCIETY OF THE PLASTICS INDUSTRY, INC., ON FEBRUARY 18, 1972

Whereas the world has committed itself to the Metric system, and

Whereas the National Bureau of Standards' report, "A Metric America—A Decision Whose Time Has Come"—has been recommended by Congress by former Secretary of Commerce, Maurice H. Stans; Now, therefore, be it

Resolved, That the Society of the Plastics Industry, Inc. supports a systematic, nationally-coordinated U.S. change-over to the metric system of measurement over a 10 year period.

Melbourne Area Chamber of Commerce,
Melbourne, Fla., March 8, 1972.

Subject: S. 2483.

Hon. Warren G. Magnuson,
Chairman, Senate Commerce Committee,
New Senate Office Building,
Washington, D.C.

Dear Senator Magnuson: The Melbourne Area Chamber of Commerce is comprised of some 800 members representing all types of businesses on Florida's Space Coast.

The Congressional Affairs Committee of the chamber has studied the bill S. 2483 concerning the adoption of the metric system and would like to express to you the result of their deliberation.

It is inevitable that industry in this country will ultimately adopt the metric system in light of its broad use throughout the world. If we implement this legislation now, it will probably require about ten years to bring about change. The position of this chamber is a recommendation that conversion to the metric system be started at the earliest possible date.

It will be appreciated if you would convey our opinion to your committee members.

Sincerely,

Howard N. Hebert, *President.*

American Newspaper Publishers Association,
New York, N.Y., March 8, 1972.

Hon. Daniel K. Inouye,
Senate Commerce Committee,
Old Senate Office Building, Washington, D.C.

Dear Senator Inouye: We are addressing you in connection with the report on the U.S. metric study being examined by the Senate Commerce Committee at hearings over which you are presiding. We did not request time for appearance at the hearings last week, and we are writing now to offer brief comment and suggest that the enclosed report which we prepared entitled "Metric System in America? The Pros and Cons" may be worthy of inclusion in the printed record of your hearings.

Membership in the ANPA is held by more than 1,000 daily newspapers having more than 90% of total U.S. daily newspaper circulation. Our association is still studying the implications of a metric system conversion, not only for the newspaper publishing business but also for the country as a whole.

However, as indicated in the enclosed report, some facets of the study and the recommendations trouble us and, therefore, we commend your committee for undertaking a review of this important matter and urge that your review be made as comprehensive as possible.

With high esteem.

Yours very truly,

Stanford Smith,
President and General Manager.

Enclosure.

Metric System in America? The Pros and Cons

A ten-year plan for United States' conversion to the metric system of measurement is off the drawing boards and now rests in the hands of Congress to determine whether this country is ready for such a revolutionary move.

This report examines the implications of the national policy question thus confronting the country as a whole. The newspaper business is only one segment of the economy which will be affected. Many broader and more difficult problems arise. This discussion is not intended as a message of advocacy or opposition.

Bill S. 2483 by Sen. Pell (R.I.), one of the major proponents of "metrication," would provide for a ten-year conversion program to make the International Metric System the official and standard measurement of the United States.

Although Sen. Pell had hoped for early hearings on his bill in the Senate Commerce Committee, none have been scheduled. On the other side of Congress, Rep. George Miller (Calif.), chairman of the House Science and Astronautics Committee, is also optimistic that hearings will be held soon although no metric system bill has been introduced in the House.

The Pell bill incorporates many of the recommendations of the U.S. Department of Commerce, submitted to Congress earlier this year in a report entitled, "A Metric America—A Decision Whose Time Has Come."

The Commerce Department report offered the following recommendations:

That the U.S. change to the metric system deliberately and carefully;

That conversion be accomplished through a coordinated national program;

That Congress assign the responsibility for guiding the change, and anticipating the kinds of special problems described in the report, to a central coordinating body responsive to all sectors of society;

That within this guiding framework, detailed plans and time-tables be worked out by these sectors themselves;

That early priority be given to educating every American schoolchild and the public at large to think in metric terms;

That immediate steps be taken by the Congress to foster U.S. participation in international standards activities;

That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs shall "lie where they fall";

That the Congress, after deciding on a plan for the nation, establish a target date ten years ahead, by which time the U.S. will have become predominantly, though not exclusively, metric; and

That there be a firm government commitment to this goal.

While the Commerce report declares that changeover costs should "lie where they fall," the Pell bill provides for accelerated depreciation of machinery and investment credit for costs incurred by conversion. The cost of conversion and who is going to pay the bill are only two of many gray areas in the Commerce report.

Depending upon who is doing the talking, the cost involved in the switch to metric varies between $10 billion and $40 billion by conservative estimates. Government estimates outside the Commerce Department set the price tag at $60 billion and many in business feel that even this estimate is too low. They say the figure is closer to $100 billion and that although it is small in relation to our trillion dollar economy, the cost of $10 billion per year for ten years will not go unnoticed by the consumer, who over the long term will pick up the tab.

Only a handful of industries now use the metric system predominantly and only those would escape the high cost of conversion. Everyone and everything else would be affected. Here are a few obvious examples. Every road sign in the nation would have to be changed. Every employee would have to be re-educated. Almost every manufacturing industry would be required to re-engineer their products, stock dual inventories during the conversion period, and convert production equipment. Even the local market-place would not remain untouched. Every grocery scale would have to be converted or replaced. Gasoline pumps would have to be adjusted. Every food processor would have to redesign every can, every package, every piece of machinery. Plumbers, electricians, carpenters, auto mechanics, and others in service-oriented occupations would probably need two sets of tools during the conversion.

Effect of conversion on newspapers would not be nearly as severe as on many other businesses. William D. Rinehart, assistant general manager of ANPA Research Institute, served as a member of the Metric System Study Advisory Panel by appointment of the Secretary of Commerce. He comments: "I am certain that our internal measuring systems of composition would continue to be used, as was found preferable by our Metric Study group of the ANPA Production Management Committee. On the other hand, we would have to convert or replace shop tools and purchase paper to metric specifications, etc. New presses and other equipment would be metric, forcing some newspapers to maintain dual spare part inventories, etc. In general, the nuisance factor would be worse than the increases in costs, as compared to most other businesses."

On the feasibility of metric conversion, Rinehart stated, "If the printing business is ever to convert, the best time for it would be when a transition is made to electronic cathode ray computerized type-setting."

Rinehart also warned the Department of Commerce that implementation of metric system conversion in those segments of the printing industry using hot metal composition would be "totally impossible" and that "resistance would be tremendous."

Evolution of a metric plant.—The idea of U.S. adoption of the metric system goes back to 1821 when President John Quincy Adams, in a report to Congress stated that although he believed adoption approached "the ideal perfection of uniformity applied to weights and measures," he rejected it because he felt that the time was not right for it. At that time the metric system was not yet firmly established throughout the rest of the world.

In the next few years, however, the United States will be the only country using pounds, quarts and yards. Presently, just four countries, Canada, United States, Australia and England are still using the inch-pound system; the three other than the U.S. have already formulated policies for conversion. As a result, international standards of weights and measures are generally set without U.S. participation. Additionally, U.S. technological advances have difficulty in finding world-wide acceptance.

Without adoption of the metric system, it is generally assumed that the United States will suffer in the area of international trade. Authorities in the Commerce Department go beyond that and say the U.S. could now can earn about $10 billion extra per year in export business if U.S. products were made to metric specifications.

However, another of their own studies, cursorily reported, found that a change to metric would have an insignificant effect on U.S. World Trade.

The Metric Study Act of 1968 (Public Law 90–472) authorized the Secretary of Commerce to conduct an investigation to determine the impact of world-wide use of the metric system on the United States. The Act itself was pushed through Congress by two of the metric advocates, Sen. Pell and Rep. Miller.

The study itself became controversial. Instead of arranging for a broad inquiry and evaluation of the metric system, the Commerce Secretary turned the project over to the National Bureau of Standards, which is comprised strictly of technical people who already were advocates of the metric system. As a result, there has been a great deal of controversy among leaders of industry and business, not over the final report iself, but mainly over what is *not* in the report.

The report was prepared by the staff of Commerce Department and technical personnel of the National Bureau of Standards. The report is, therefore, the product of government employees who, some feel, never permitted a true evaluation by people outside their staff, despite protest by members of the Metric System Study Advisory Panel, the 45-member group established to advise the Commerce Secretary in connection with the feasibility study of conversion. William D. Rinehart is one of that group.

According to Rinehart, the staff accepted criticism of the group and then prepared to report without considering the criticism. A disclaimer, demanded by panel members which would state that the final report does not in any way represent the thinking of their organizations, was not included in the final report.

The U.S. metric study concluded that eventually the U.S. will have to join the rest of the world in the use of the metric system as the predominant common language of measurement. Rather than drifting to metric with no national plan to help sectors of our society and guide our relationships abroad, a carefully planned transition in which all sectors participate voluntarily was deemed preferable. "The change will not come quickly," the report stated, "nor will it be without difficulty; but Americans working cooperatively can resolve this question once and for all."

At various times in our history, since President Adams' report was submitted to Congress, groups of scientists and physicists have sought to obtain legislation to force the use of the metric system in the U.S. On each occasion, hearings in Congress over the use of the metric system were explosive and uprisings of the business community have always beaten down the attempts.

Many members of the study group feel the final Commerce report ignores and distorts the actual study findings and that it is entirely different from what Congress requested. Some are looking forward to Congressional hearings on the subject for a chance to offer an opinion that they should have been allowed to offer in the report.

Some feel that the final report contains statistics that are distorted to prejudice the argument in favor of forced metric adoption. The representatives of major industries on the Study Panel oppose *forced* conversion to metric. They prefer that use of either metric or English measure be left to individual company management decision. However, the final report shows that 30% of all employees are now using metric systems. In actuality, this figure is the number of employees in companies who say they now make *some* use of metric measurements. General Motors uses metric in ½ of 1% of all its operations. Yet the Bureau of

Standards lumped the half million General Motors employees in the 30% of all employee's figures.

When Congress holds hearings, the whole controversy will be aired and a national decision can eventually be made. Newspapers will play an important role in that national debate—not only as an affected business but as leaders of public opinion.

STANFORD SMITH,
President and General Manager.

NATIONAL CONFERENCE ON WEIGHTS AND MEASURES,
March 13, 1972.

Hon. WARREN G. MAGNUSON,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MAGNUSON: We were offended, as we are certain that you were, to hear our nation referred to as the "illiterate giant among nations," regarding our measurement system.

Yet, in retrospect, after reading the U.S. Metric Study (PL 90-472) recently submitted to Congress by the then Secretary of Commerce Stans, we could only conclude that the truth hurt.

Living in a State where metric labeling is commonplace in the market because of our proximity and commercial trade with the metric nations of the Far East, it seems a paradox that we must now seek to ratify that which was established as legally permissive on July 28, 1866—The Metric System (14 Stat. 339).

We live in hope, and are awed by the prospect, that *you* may resolve 200 years of national indecision by voting to adopt the Metric System.

Will you?

Very truly yours,

GEORGE E. MATTIMORE,
Chairman, Committee on Education, Administration and Consumer Protection.

SOCIETY OF AMERICAN FORESTERS,
Washington, D.C., March 15, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, Senate Committee on Commerce, Senate Office Building, Washington, D.C.

DEAR SENATOR MAGNUSON: As an organization representing forestry professionals in America, the Society of American Foresters is directly concerned with the scientific management of our nation's forest lands. Proposals to convert units of measurement used in forestry to the metric system are of particular interest to the Society's 17,500 members.

The Society has a Committee on Metrication to keep its members informed, educated and coordinated on the progress of metrication, to initiate ideas and proposals for improvement and modernization of forestry and forest products measurement systems and to make recommendations back to the Society on metrication positions or policies as the need arises.

The Society recognizes the eventual impact of metrication on forest land management and forestry activities and is prepared to give professional opinions on the development of any pending proposals for conversion to the metric system which affect forest lands.

We respectfully request this letter be included in the hearing record conducted February 29 and March 1, 1972 on this subject.

Sincerely,

ZEBULON W. WHITE, *Chairman.*

GENERAL ELECTRIC CO.,
New York, N.Y., March 17, 1972.

Hon. DANIEL K. INOUYE,
U.S. Senate, New Senate Office Building,
Washington, D.C.

DEAR SENATOR INOUYE: This is to acknowledge and thank you for your letter of February 29 regarding our interest in submitting a written statement for the record of your recent hearings on United States conversion to the metric system of measurements.

In accordance with your suggestion, I am enclosing a memorandum which briefly summarizes the General Electric Company's views and recommendations on this important matter.

You will note that we favor increasing adoption of the metric system and certain governmental measures to encourage and to facilitate further transition.

But we also oppose establishment of a fixed timetable as has been proposed. Such a course would force untimely obsolescence and premature change in all the "designs and tools of commerce." This would be an unjustified burden on social costs, compared especially with other priorities now facing our society.

There is further concern that a forced, rather than an economically timed, conversion would add to our balance-of-payment burdens and job dislocations, unless protective measures now unpopular internationally were taken for some period of time.

We appreciate the opportunity to put our views on metric conversion before your committee and will be pleased to respond to any questions on this submission that you or your associates may wish to pursue.

Sincerely,

J. F. YOUNG,

Enclosure.

Memorandum to: Senate Committee on Commerce, Subcommittee on International Foreign Trade and Tourism.

Subject: U.S. Conversion to the Metric System of Measurement.

Reference: Hearings of February 29 and March 1, 1972 Chaired by Senator D. K. Inouye.

This memorandum briefly summarizes the views of the General Electric Company on the above subject and is based upon:

(a) Testimony in favor of the congressional authorization of the metric study carried out by the Department of Commerce,

(b) Cooperation with the Department of Commerce during their study including advisory committee participation and submission of detailed responses to industry questionnaires to appraise the costs and benefits of conversion, and

(c) Review of the bills now before the Senate including the Joint Resolution proposed by the Administration.

1. There are a number of areas of the U.S. economy that have already converted to the metric system since Congress legalized its use over 100 years ago.

2. This trend will continue with some impetus from growing multinationalism in business and trade, from current conversion in the Commonwealth nations and from progress in implementation of the EEC.

3. With time, the U.S. must increasingly engage first with metric measures and later with metric modules in all areas of commerce. Some actions should be taken on a national basis now to prepare for this increasing domestic exposure to the metric system.

4. One such action is to immediately give more emphasis to metric measures along with the traditional customary measures at all levels of our educational system including adult education. Some additional expenditures will probably be required to accomplish this, but proper attention to timing may allow schoolbooks and educational materials to be revised with metric units on a normal replacement schedule, rather than on any crash basis. Opportunity for improved course restructuring has been foreseen in some subject areas.

5. Another advantageous action would be an early national start on "bilinguality" in widely available publications, such as newspapers, magazines, daily meteorological reports, government documents, etc., to begin making the public aware of, and familiar with, metric units.

6. Each occasion for revision and reissuance of legal documents, such as regulations and codes, should be encouraged to include dual measures to aid ultimate transition to metric measures. This same philosophy should also be applied in certain other areas, for example, the packaging of consumer goods. This may require a nationally approved scale of conversion equivalents from the customary system to the metric system to assure uniformity in application.

7. Further metrication entails increased activity in international standards work, with the government playing the role proposed in S. 1798, as modified by committee print #1, the "International Voluntary Standards Cooperation Act of 1971."

8. It is possible that antitrust problems might arise from attempts to establish conversion plans in any specific sector of industry or trade. Suitable legislative procedures should be developed to alleviate this possible problem.

9. By the very nature of their various activities, not all areas of business, commerce and industry can convert in similar time periods, nor is it necessarily feasible for all to begin at the same time or for all to complete conversion at the same date. Any legislation should be opposed that would establish a point in time after which the metric system would be the only official system in the U.S.

10. Studies indicate that U.S. export trade will not increase significantly as a result of conversion. But if it were to increase by the $600 million figure mentioned during the above hearings, this is an insignificant return on the estimated $60 billion cost involved with a ten year changeover mandate. There should be great concern that during the time any measurement-sensitive industry is converting, and thereby incurring changeover and/or duplication costs, its markets will be wide open to imports from foreign manufacturers already producing a metric product. Such an occurrence will cause drastic changes in the domestic economy with particular dislocation or depression of related American labor and industry.

11. Congress may wish to consider whether temporary tariffs might help to equalize costs between domestic and foreign manufacturers in any industry during the time of its conversion. These measures would be utilized only as a transitional device. If used, such tariffs should be only for a limited period of time in any one industry, and should be structured to encourage manufacturers in that industry to convert during that time. This might necessitate some procedure whereby an industry, in conjunction with its users and with government representatives, would develop a timetable for conversion. Following agreement on this timetable, the industry (or some Metrication Board) would then request Congress for a limited time-period tariff for that industry, in which period the changeover for that industry would be accomplished. It could be argued that foreign nations will view this tariff as a new trade barrier. On the contrary, when the conversion is accomplished, a present trade barrier (the different measurement system) will be removed, which is to the potential future benefit of all nations. To add a temporary tariff to keep costs equal for all sides during conversion could represent an acceptable price for others to pay to eliminate the present barrier.

12. Based on the above, formation of any Board or Commission for metrication which would have mandatory powers and/or which would be solely under any Federal agency, such as the Department of Commerce, is not appropriate at this time. However, in order that there be some central organization to maintain knowledgeability about changes, progress and programs, formation of an independent Board with broadly representative members from government, labor, science, consumer groups and industry seems desirable. Members should be appointed by the President. This Board should have no mandatory or compulsory power. But it should be authorized to develop a conversion plan through use of recommendations from supplier-user groups who have openly worked out timing and other details that are economically practicable for these groups.

13. Separate subsidies such as included in S. 2483 would add little if any incentive to accept conversion or to find low-cost routes to its accomplishment.

14. There is no question that conversion will be very expensive to the U.S. economy. The above steps should help to hold the costs down, particularly inasmuch as suppliers and their customers will be encouraged to set their own timetables. To this end, use of governmental agencies' purchasing power as a lever to force rapid conversion should be opposed. These agencies should justify economically their conversion plans in the same way as other users, and in conjunction with their suppliers. Testimony to this point was expressed by Assistant Secretary James H. Wakelin, Jr., at the subcommittee hearing on February 29.

15. In summary, application of the above comments to Senator Pell's and Congressman McClory's bills, S. 2483, H.R. 12307 and H.R. 12555 respectively, indicates they should be opposed at this time because of the mandatory nature of their provisions establishing one official system after ten years, their regulations requiring Federal agencies to convert promptly, their singular governmental control of the "Board" and the subsidies in S. 2483. The Administration's Joint Resolution, J.R. 1092, has better applicability now but is open to challenge on its provision to make the metric system predominant (though not exclusive) in ten years. There should be no such arbitrary time limit, and certainly not until the Board has found the best practicable time schedules from the supplier-user groups' planning work.

The American Institute of Architects,
Washington, D.C., March 20, 1972.

Hon. Warren G. Magnuson,
Chairman, Committee on Commerce, U.S. Senate, Washington, D.C.

Dear Mr. Chairman: The American Institute of Architects, a professional association representing 24,000 members, wishes to go on record as strongly supporting the adoption of S. 2483, The Metric Conversion Act of 1971.

Our current support for conversion to metric weight and measures dates back to April, 1970 when the AIA Board of Directors passed the following resolution:

"*Resolved*, That the Board of Directors of The American Institute of Architects urges the completion of studies authorized by Public Law 90–472, particularly as these studies relate to the construction industry, and further urges that the metric system be adopted as the national standard of weights and measures in the United States of America."

A similar resolution was passed in 1944 by the AIA Board of Directors.

In October, 1970, The American Institute of Architects participated in the studies undertaken by the Secretary of Commerce responsive to Public Law 90–472. Testimony urging adoption of the metric system was presented to the National Metric Study Conference on Construction.

We are opposed to the concept of Evolutionary Metrication, or "let it happen naturally." Increasing use of the metric system without some program of coordination could cause difficulties which might eventually reach disaster proportions. Under present conditions, it is the architect's responsibility to coordinate the activities of the various disciplines and skills within the building industry and to interrelate manufactured building materials and components with each other and translate the whole through construction documents into a buildable structure. If the other parts of the building industry were to begin to convert only as their particular needs required and completely without coordination, the architect's job would be virtually impossible.

Imagine the difficulties that would be encountered, for example, if gypsum wallboard suddenly came off the line one meter by 2.5 meters instead of four feet by eight feet as is now common, without a corresponding revision in codes to allow respacing of wood studs and a similar change in lumber sizes and lengths. The backbone of residential construction, the single-family wood frame house, would no longer be practical using those products. And, architects and builders would be powerless to correct the situation. The spacing of the studs could not be changed until the load tables were revised and accepted by the 8,000 various local and national model codes. It is entirely unlikely that any organization would expend funds to revise load tables until lumber sizes changed. There are dozens of such examples, many much more complex than the one mentioned. The result would be chaos.

If that portion of the construction industry manufacturing products used and specified by structural engineers were to convert to metric measure without a corresponding change taking place in the architectural products which fit that structural system, architects would find it difficult, if not impossible, to fit the two together. At the very least, the mating would be more expensive. The result could be steeply rising construction costs which neither the architect nor the engineer could prevent.

One might suppose that factory-made buildings or some form of building systems would solve the problems and offset the increase in building cost, but it must be remembered that the vast majority of building in this country is done in the age-old method of putting many parts together to make the whole, and in spite of the inroads being made by systems, such will be the case for many years to come. While the present system is far from ideal, it is vastly superior to that which would result from indiscriminate conversion to the metric system within the construction industry.

On the other hand, The American Institute of Architects believes in, and strongly supports the concept of Planned Metrication as exemplified in S. 2483. The effects on the architectural profession of a properly planned and well organized program of metrication would be much less severe than those which could result from evolutionary metrication. The "optimum time period" for architects to convert will be far less than the fixed time period of 10 years, although no one is prepared to say exactly how long it would take. Architects have converted to the metric system for a single overseas project, where the metric system was in general use, but conversion to predominant use of the metric system is another matter. Our conversion time would be small but could not even begin until the conversion of product sizes (or at least catalog sizes) and the revision of design tables and their acceptance by the various code groups was well under way.

The direct cost to architects would be primarily in the re-education of employees and the purchase of new standards and reference materials; both of those costs would be relatively small. The architectural profession realizes, however, that during the period of the conversion it will be required to spend additional effort in terms of dual dimensioning and aiding others on the construction team in interpreting the new dimensioning system. Greater cost will continue for the architect so long as the conversion is taking place, and probably the largest portion of the increase will occur toward the end of the conversion period. Therefore the minimum cost to architects will occur if the conversion is rapid.

Further, the procedure and organization of the construction industry-wide conversion will affect the architect's cost. Since our major problems are in coordination of materials, we feel that related materials and methods must be changed as nearly together as is possible and not just as materials and methods become obsolete.

In addition, we feel that modular coordination, standardized component sizes and dimensional coordination should be incorporated into the system conversion as is the case in the United Kingdom.

Concerning Planned Metrication, we feel that the conversion should take place in a planned ten year period. Thus, the conversion will be more orderly, take less time and allow the easier incorporation of a standardized dimensional framework into the product and dimensional standards of the United States.

We believe that the major problems which will be encountered by architects in metrication will be:

1. Conversion of the design thinking process to metric measure as the different sizes relate to human scale and proportion.
2. Re-education of architects and their personnel.
3. Work on additions and alterations to existing buildings where both drawings and structure are in customary measure.
4. Dual dimensioning during the conversion period.
5. Interpretation of drawings done in metric under field conditions while the metric system is still new to both architect and contractor.
6. Obtaining, at the time needed, catalog and design data in metric measure.
7. Obtaining when needed, engineering standards, handbooks and tables.
8. Obtaining acceptance of the new standards and materials by code groups and local building officials as the inevitable exceptions begin to appear.

The problems of the construction industry (which represents approximately ten percent of the Gross National Product) must be recognized in establishing a National Metric Plan. Representatives of the various segments of the construction industry should be appointed to the advisory boards required by S. 2483. The design professions, as an essential segment of the industry, are well equipped to provide valuable input to the advisory boards. We suggest that the following recommendations concerning the construction industry be considered in establishing a National Metric Plan:

1. Make a detailed analysis of the programs and procedures adopted by the United Kingdom in their metrication program, including those methods related to dimensional coordination.
2. Set up some orderly, continuing mechanism to coordinate standards and codes within the metric system to alleviate the continuation of the present state of disorganization.
3. Set up some mechanism to aid in conversion of design standards and codes to coordinate them with the modular dimensional coordination standards. If, for example, a basic module of 10 centimeters (about 4") should be selected, wallboard might be manufactured in 1.20 x 2.40 meters (a variance from present 4'-0" x 8'-0" standards of about ¾" and 1½"). The variation from present standards is small but still significant for field assembly. It would simplify such things as code requirements if the standard 16" stud spacing were changed to 40 centimeters.
4. Influence building component manufacturers to coordinate their products so that they interface with other components and materials in an orderly, modular fashion without the need for additional modification. Some groundwork for

such a modular coordination system has been accomplished by the American National Standards Institute's Committee A–62, "Pre-Coordination of Building Components and Systems". The objectives of that Committee should be carefully considered in realizing the coordination potentials of metric conversion.

5. In connection with the modular coordination system, avoid only a direct conversion in numbers but rather require standardization in metric sizes so that building components and materials relate to each other and to a logical framework for nominal dimensional coordination. This might be accomplished by the establishment of national dimensional standards, on which some work has been done by ANSI Committee A–62. A detailed study of the British experience in the area of dimensional coordination would seem appropriate even though their final solutions may differ from ours. To be useful, the dimensional coordination standards should be integrated with the basic module of the modular coordination system so that components would be interchangeable.

One orderly approach to planned metrication for the construction industry would be to establish an agency at Federal level and give it the funds and responsibility to:

1. Establish liaison with all segments of the construction industry and together with representatives of the industry within a fixed time period (perhaps three years):
   - (a) Establish an overall plan for metrication.
   - (b) Develop a program for conversion.
   - (c) Assign mandatory time periods to each stage of the program.
   - (d) Put the program into effect.
2. Remain in being during the entire period of the conversion to:
   - (a) Follow up and assist the industry toward orderly conversion.
   - (b) Encourage and aid the industry in coordination of conversion activities.
3. While the final program would necessarily include a great deal more detail, a possible basic program outline might be:
   - (a) Period for preliminary preparation (one or two years).
   - (b) Period of education (begin at once and continue throughout the entire conversion period).
   - (c) Period for revising and re-issuing building regulations and standards (two years to three years, if possible).
   - (d) Period for producing metric components (begin as soon as practical and complete by eighth year).
   - (e) Period during which production of drawings is done in metric measure (begin as soon as practical and complete by end of eighth year).
   - (f) Period during which construction of buildings using metric measure takes place (begin with first drawings and be all metric by end of tenth year).

In summary, The American Institute of Architects feels that conversion to the metric system has tremendous potential for the building industry. A union of metrication and dimensional coordination would enable the development of a rational, disciplined and systematic approach to building and design. It can provide the impetus to upgrade codes and standards and provide a base for less expensive in-place costs.

Finally, if handled creatively and cooperatively, it will provide excellent opportunities for unification of the building industry into the strong working team that it deserves to be.

We stand ready to offer our services in assisting with the implementation of conversion to the international metric system.

Sincerely yours,

MAX O. URBAHN, FAIA.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC.
New York, N.Y., March 20, 1972.

Hon. DANIEL K. INOUYE,
New Senate Office Building, U.S. Senate,
Washington, D.C.

DEAR SENATOR INOUYE: The American National Standards Institute has been requested to present its views and recommendation on the administration's proposal to establish a national policy relating to conversion to the metric system in the United States. The proposal is contained in H.J. Res. 1092 introduced in the House of Representatives. Administration witnesses also presented this proposal to Senate Commerce Committee on February 29, 1972.

We are sure that you will appreciate that a federation such as ANSI has an extremely difficult task in arriving at a position on legislation with the long-term impact of the administration's proposal. ANSI membership encompasses virtually all national trade, technical, professional, labor, and consumer organizations having a major interest in the development and promulgation of national and international standards. It also cuts across many major segments of industry in which proposals to convert to the metric system would have a significant impact.

This diversity of interest, which includes rather sharply divided opinion on the administration's proposal, coupled with the unfortunate delay in its introduction, i.e., only some two weeks ago and almost eight months after the metric study was submitted to Congress, makes it impossible to present final comments and recommendations at this time. Further, in this letter we are providing some general observations on the proposal based upon our rather extensive involvement in the original metric study and reports. As we are able to develop additional recommendations, they will be submitted for your consideration.

To provide the Congress with recommendations on the most efficient and effective course of action on increased use of S.I. units, ANSI is taking the following steps:

1. A copy of the administration's proposal, along with the submitted statement of purpose and need, are being sent to the entire membership of ANSI with a request that they present their individual positions, either in favor of the administration position or in opposition to its enactment, along with comments and suggestions.

2. This same material is being submitted to the Institute's Metric Advisory Committee which is broadly representative of a cross-section of industrial opinion. The MAC has been actively engaged in consideration of the impact of increased S.I. usage since before Congress authorized the national metric study in P.L. 90-472.

3. The results of these surveys will be presented, with recommendations on ANSI policy position, to the Institute's Board of Directors and communicated to Congress.

METRIC ACTION BY ANSI

ANSI will continue to work with all segments of industry and with government as we have over the past fifty-four years to coordinate the development of standards to meet the actual needs identified by either change or increased adaptation of S.I. units. ANSI has an expressd policy that all standards proposed for international adoption must be expressed in S.I. units along with any other units used.

In addition to specific standards development, ANSI will continue to develop U.S. positions and assure participation in the work of ISO/TC 12 on Quantities, Units, Symbols, Conversion Factors and Conversion Tables. This committee is responsible for development and revision of ISO/R 1000, which contains the basic rules for the use of S.I. units. A copy of the current ISO/R 1000 is attached which you may wish to include in the printed hearings on metric legislation.

ANSI will continue to develop both generalized and specific educational and information documents to assist industry, government and the public to become familiar with the meaning applicability of metric terms and measure in daily life. We firmly believe that the process of education and information must begin immediately and should have the full support of the Congress.

ANSI will continue to coordinate the development of national standards in cooperation with its organizational members, industry, labor, consumers and government, to assure that standards are developed in anticipation of metric change within a practical frame of need and use. We feel that ANSI's primary contribution to any conversion which may occur is in a strengthened and expanded effort to work with standards-developing groups, many of which have adopted metric use policies, as well as standards users, to bring about a voluntary, well coordinated effort to meet the needs of America for standards whether expressed in metric or customary units of measure. This is the primary purpose of ANSI.

The need for increased industry-government cooperative action in international standards participation is essential to any successful metric plan.

While conversion is taking place we must in the interests of U.S. trade assure that sound American standards, engineering practices and, in some cases actual products, are not eliminated from international use. The precipitant adoption of nominal metric sizes in international standards on the guise of metric conversion, for example, would present an almost insurmountable non-tariff barrier to many U.S. produced products which will be in use for many years to come. The development of international standards requires practical consideration of existing as well as so-called future standards. The position of the United States in the continuing evolution of international standards will be considerably strengthened by enactment of S. 1798, the International Voluntary Standards Cooperation Act pending before the Senate Commerce Committee. S. 1798 is essential with or without metric legislation.

GENERAL OBSERVATIONS ON H. J. RES. 1092

While ANSI is not in a position at this time to endorse or oppose enactment of the administration's proposal, there are a number of principles regarding any plan which should be considered.

In the first instance ANSI feels that if a National Metric Conversion Board is established by statute such a Board should evolve a national policy rather than merely endorse one defined by joint Congressional Resolution.

It is highly improbable, if not impossible, for a Board, as envisioned in the administration's proposal, to develop policies and plans in the short span of one year. We feel that a minimum of two years after funding is available will be required.

A policy on metric conversion is not a simple go or no go decision. Timing is critical and cannot in our view be determined by arbitrary periods, e.g., ten years from the date of enactment of an authorizing resolution. Time limits and phasing should be an integral part of the plan and policy which a Board might recommend.

We believe the Congress of the United States will want to take a new, fresh and in-depth look at any proposed plan which the Board may propose. We feel that the viewpoints of vitally affected segments of society, including government, industry, labor and consumers can only be objectively assessed if requested on the basis of a proposed policy and plan. The hard test will come when all segments of society must consider the impact of such a proposal.

Further study is required on the composition and structure of the proposed Board. The ultimate acceptability of any proposal may well depend in large measure on the credibility of the membership. We find it difficult to accept a Board of twenty-one undefined and unidentified persons broadly representative of the American society. Because the essential element of metric conversion in every nation in the world has been the development, promulgation and use of sound standards, we would strongly suggest that at least a portion of the Board must represent either individuals or organizations with both experience and responsibility in national and international standardization.

It is also somewhat difficult to conceive of a Board directly responsible to a single department or agency of government as proposed by the administration. While for practical purposes we would support such a Board being assigned to a department or agency for administrative and/or technical support, we believe such a Board should be independent, should be appointed by the President of the United States, and should report its recommendations to the President for submittal to the Congress.

Mr. Chairman, ANSI appreciates the opportunity to present this preliminary statement which we would appreciate being included in the record of your current hearings.

Sincerely,

DONALD L. PEYTON, *Managing Director.*

Enclosure.

UDC 53.081 : 003.62 : 004.1

Ref. No. : ISO/R 1000-1969(E)

ISO RECOMMENDATION
R 1000

RULES FOR THE USE OF UNITS
OF THE INTERNATIONAL SYSTEM OF UNITS
AND A SELECTION
OF THE DECIMAL MULTIPLES AND SUB-MULTIPLES
OF THE SI UNITS

1st EDITION
February 1969

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For each individual country the only valid standard is the national standard of that country.

At the suggestion of its Metric Advisory Committee, the American National Standards Institute has reprinted ISO Recommendation R 1000 in order to achieve the broadest possible circulation of this important document throughout American industry.

The Metric Advisory Committee through studies, forums, evaluation, monitoring, and other means, is developing an opinion as to the broader use and character of metric measures and related standards in order to formulate a proper and dynamic policy for the Institute in furtherance of its responsibilities in both national and international standardization.

The International Organization for Standardization (ISO) is a non-treaty organization comprised of national standards bodies of some fifty-six nations. The Standards Institute is one of the founding members and is this nation's representative member. Copies of all ISO Recommendations and other informational documents published by ISO may be obtained in the United States through the Standards Institute.

BRIEF HISTORY

The ISO Recommendation R 1000, *Rules for the use of units of the International System of Units and a selection of the decimal multiples and sub-multiples of the SI units*, was drawn up by Technical Committee ISO/TC 12, *Quantities, units, symbols, conversion factors and conversion tables*, the Secretariat of which is held by the Dansk Standardiseringsraad (DS).

Work on this question led, in 1967, to the adoption of a Draft ISO Recommendation.

In March 1968, this Draft ISO Recommendation (No. 1557) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia
Austria
Belgium
Brazil
Canada
Chile
Czechoslovakia
Denmark
Finland
France
Germany
Hungary
India
Iran
Iraq
Ireland
Israel
Italy
Japan
Korea, Dem. P. Rep. of
Netherlands
New Zealand
Poland
Romania
South Africa, Rep. of
Switzerland
Thailand
Turkey
U.A.R.
United Kingdom
U.S.S.R.

Two Member Bodies opposed the approval of the Draft :

Norway
Sweden

Since the publication of this Draft was a particularly urgent matter, the ISO Council decided, at its 1967 meeting, that the document be published as an ISO RECOMMENDATION after its approval by the ISO Member Bodies.

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American National Standards Institute
1430 Broadway New York, N.Y. 10018

ISO/R 1000-1969(E)

ISO Recommendation **R 1000** **February 1969**

RULES FOR THE USE OF UNITS
OF THE INTERNATIONAL SYSTEM OF UNITS
AND A SELECTION
OF THE DECIMAL MULTIPLES AND SUB-MULTIPLES
OF THE SI UNITS

1. SCOPE

This ISO Recommendation gives rules for the use of units of the International System of Units and for forming and selecting decimal multiples and sub-multiples of the SI units for application in the various fields of technology.

2. GENERAL

2.1 The name Système International d'Unités (International System of Units), with the abbreviation SI, was adopted by the 11th Conférence Générale des Poids et Mesures in 1960.

The coherent units are designated "SI units".

2.2 The International System of Units is based on the following six base-units :

metre (m)
kilogramme (kg)
second (s)
ampere (A)
kelvin (K)
candela (cd)

as units for the base-quantities : length, mass, time, electric current, thermodynamic temperature, and luminous intensity.

2.3 The SI units for plane angle and solid angle, the radian (rad) and the steradian (sr) respectively, are called supplementary units in the International System of Units.

2.4 The expressions for the derived SI units are stated in terms of base-units; for example, the SI unit for velocity is metre per second (m/s).

For some of the derived SI units special names and symbols exist; those approved by the Conférence Générale des Poids et Mesures are listed below :

Quantity	Name of SI unit	Symbol	Expressed in terms of basic or derived SI units
frequency	hertz	Hz	$1\ \mathrm{Hz} = 1\ \mathrm{s}^{-1}$
force	newton	N	$1\ \mathrm{N} = 1\ \mathrm{kg \cdot m/s}^2$
work, energy, quantity of heat	joule	J	1 J = 1 N m
power	watt	W	1 W = 1 J/s
quantity of electricity	coulomb	C	1 C = 1 A·s
electric potential, potential difference, tension, electromotive force	volt	V	1 V = 1 W/A
electric capacitance	farad	F	1 F = 1 A s/V
electric resistance	ohm	Ω	1 Ω = 1 V/A
flux of magnetic induction, magnetic flux	weber	Wb	1 Wb = 1 V·s
magnetic flux density, magnetic induction	tesla	T	$1\ \mathrm{T} = 1\ \mathrm{Wb/m}^2$
inductance	henry	H	1 H = 1 V·s/A
luminous flux	lumen	lm	1 lm = 1 cd·sr
illumination	lux	lx	$1\ \mathrm{lx} = 1\ \mathrm{lm/m}^2$

It may sometimes be advantageous to express derived units in terms of other derived units having special names; for example, the SI unit of electric dipole moment (A·s·m) is usually expressed as C·m.

2.5 Decimal multiples and sub-multiples of the SI units are formed by means of the prefixes given below

Factor by which the unit is multiplied	Prefix	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{2}	hecto	h
10	deca	da
10^{-1}	deci	d
10^{-2}	centi	c
10^{-3}	milli	m
10^{-6}	micro	µ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

The symbol of a prefix is considered to be combined with the unit symbol to which it is directly attached, forming with it a new unit symbol which can be raised to a positive or negative power and which can be combined with other unit symbols to form symbols for compound units.

Examples

$1\ \mathrm{cm}^3 = (10^{-2}\mathrm{m})^3 = 10^{-6}\mathrm{m}^3$

$1\ \mu\mathrm{s}^{-1} = (10^{-6}\mathrm{s})^{-1} = 10^{6}\mathrm{s}^{-1}$

$1\ \mathrm{mm}^2/\mathrm{s} = (10^{-3}\mathrm{m})^2/\mathrm{s} = 10^{-6}\mathrm{m}^2/\mathrm{s}$

Compound prefixes should not be used; for example, write nm (nanometre) instead of mµm.

3. RULES FOR THE USE OF SI UNITS AND THEIR DECIMAL MULTIPLES AND SUB-MULTIPLES

3.1 The SI units are *preferred*, but it will not be practical to limit usage to these; in addition, therefore, their decimal multiples and sub-multiples, formed by using the prefixes, are required.

In order to avoid errors in calculations it is essential to use coherent units. Therefore, it is strongly recommended that in calculations only SI units themselves be used, and not their decimal multiples and sub-multiples.

3.2 The use of prefixes representing 10 raised to a power which is a multiple of 3 is especially recommended.

NOTE. – In certain cases, to ensure convenience in the use of the units, this recommendation cannot be followed; column 5 of the tables in the Annex gives examples of these exceptions.

3.3 It is recommended that only one prefix be used in forming the decimal multiples or sub-multiples of a derived SI unit, and that this prefix be attached to a unit in the numerator.

NOTE. – In certain cases convenience in the use requires attachment of a prefix to both the numerator and the denominator at the same time, and sometimes only to the denominator. Column 5 of the tables in the Annex gives examples of these exceptions.

4. NUMERICAL VALUES

4.1 When expressing a quantity by a numerical value and a certain unit it has been found suitable in most applications to use units resulting in numerical values between 0.1 and 1000.

The units which are decimal multiples and sub-multiples of the SI units should therefore be chosen to provide values in this range; for example,

observed or calculated values	can be expressed as
12 000 N	12 kN
0.00394 m	3.94 mm
14 010 N/m²	14.01 kN/m²
0.0003 s	0.3 ms

4.2 The rule according to clause 4.1 cannot, however, be consistently applied. In one and the same context the numerical values expressed in a certain unit can extend over a considerable range; this applies especially to tabulated numerical values. In such cases it is often appropriate to use the same unit, even when this means exceeding the preferred value range 0.1 to 1000.

4.3 Rules for writing symbols for units are given in ISO Recommendation R 31, Part . . . * : *General principles concerning quantities, units and symbols.*

5. LIST OF UNITS

For a number of commonly used quantities, examples of decimal multiples and sub-multiples of SI units, as well as of some other units which may be used, are given in the Annex to this document.

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* At present at the stage of draft proposal.

ANNEX

ANNEX

List of SI units and a selection of recommended decimal multiples and sub-multiples of the SI units together with other units or other names of units which may be used

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
PART 1 : SPACE AND TIME						
1-1.1	plane angle	rad (radian)	mrad µrad		degree (. . .°), $1° = \frac{\pi}{180}$ rad minute (. . .'), $1' = \frac{1°}{60}$ second (. . ."), $1'' = \frac{1'}{60}$ grade (. . .g), $1^g = \frac{\pi}{200}$ rad	The units degree and grade, with their decimal subdivisions, are recommended for use when the unit radian is not suitable.
1-2.1	solid angle	sr (steradian)				
1-3.1. . .7	length	m (metre)	km mm µm nm	dm cm		1 nautical mile = 1852 m
1-4.1	area	m^2	km^2 mm^2	dm^2 cm^2	hectare (ha), 1 ha = 10^4 m^2 are (a), 1a = 10^2 m^2	

(1)	(2)	(3)	(4)	(5)	(6)	(7)
1-5.1	volume	m^3	mm^3	dm^3 cm^3	hectolitre (hl), 1 hl = 10^{-1} m^3 litre (l), 1 l = 10^{-3} m^3 = 1 dm^3 centilitre (cl), 1 cl = 10^{-5} m^3 millilitre (ml), 1 ml = 10^{-6} m^3 = 1 cm^3	In 1964 the Conférence Générale des Poids et Mesures adopted the name litre (l) as the synonym for cubic decimetre (dm^3) but discouraged the use of the name litre for precision measurements.
1-6.1	time	s (second)	ks ms µs ns		day (d), 1 d = 24 h hour (h), 1 h = 60 min minute (min), 1 min = 60 s	Other units such as week, month and year (a) are in common use.
1-8.1	angular velocity	rad/s				
1-10.1	velocity	m/s			kilometre per hour (km/h) 1 km/h = $\frac{1}{3.6}$ m/s	1 knot = 0.514 444 m/s
AT II : PERIODIC AND RELATED PHENOMENA						
2-3.1	frequency	Hz (hertz)	THz GHz MHz kHz			
2-3.2	rotational frequency	s^{-1}			revolution per minute revolution per second	

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
PART III : MECHANICS						
3-1.1	mass	kg (kilogramme)	Mg g mg μg		tonne (t), 1 t = 10^3 kg	The metric carat (1 metric carat = 2 × 10^{-4} kg) is used for commercial transactions in diamonds, fine pearls and precious stones.
3-2.1	density (mass density)	kg/m³	Mg/m³	1 kg/dm³ = 1 g/cm³	1 t/m³ = 1 kg/l = 1 g/ml g/l	For line (l) see item 1-5.1.
3-5.1	momentum	kg·m/s				
3-6.1	moment of momentum, angular momentum	kg·m²/s				
3-7.1	moment of inertia	kg·m²				
3-8.1 3-8.2	force and weight	N (newton)	MN kN mN μN	daN		

(1)	(2)	(3)	(4)	(5)	(6)	(7)
3-10.1	moment of force	N·m	MN·m kN·m µN·m	daN·m		
3-11.1 3-11.2	pressure and stress	N/m^2	GN/m^2 MN/m^2 kN/m^2 mN/m^2 $\mu N/m^2$	daN/mm^2 N/mm^2 N/cm^2	1 hbar = 10^7 N/m^2 1 bar = 10^5 N/m^2 1 mbar = 10^2 N/m^2 1 µbar = 10^{-1} N/m^2	The hectobar (hbar) is used in certain fields in some countries. The name "pascal" is given to the newton per square metre in a certain number of countries.
3-19.1	viscosity (dynamic)	$N{\cdot}s/m^2$	$mN{\cdot}s/m^2$		centipoise (cP) 1 cP = 10^{-3} $N{\cdot}s/m^2$	
3-20.1	kinematic viscosity	m^2/s	mm^2/s		centistokes (cSt) 1 cSt = 10^{-6} m^2/s	
3-21.1	surface tension	N/m	mN/m			
3-22.1	energy, work	J (joule)	GJ MJ kJ mJ		kilowatt hour (kWh) 1 kWh = 3.6×10^6 J = 3.6 MJ electronvolt (eV) 1 eV = $(1.602\,10 \pm 0.000\,07) \times 10^{-19}$ J	The units Wh, kWh, MWh, GWh and TWh are used in the electrical industry. The units keV, MeV and GeV are used in accelerator technology.
3-23.1	power	W (watt)	GW MW kW mW µW			

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	impact strength	J/m^2	kJ/m^2	daJ/cm^2 J/cm^2		
PART IV : HEAT						
4-1.1	thermodynamic temperature	K (kelvin)				
4-2.1	Celsius temperature				degree Celsius (°C)	
4-1.1 4.2.1	temperature interval	K			°C	1 °C = 1 K
4-3.1	linear expansion coefficient	K^{-1}			°C^{-1}	
4-4.1	heat, quantity of heat	J	TJ GJ MJ kJ mJ			
4-5.1	heat flow rate	W	kW			
4-6.1	density of heat flow rate	W/m^2	MW/m^2 kW/m^2			

(1)	(2)	(3)	(4)	(5)	(6)	(7)
4-7.1	thermal conductivity	W/(m·K)			W/(m·°C)	
4-8.1	coefficient of heat transfer	W/(m^2·K)			W/(m^2·°C)	
4-10.1	heat capacity	J/K	kJ/K		kJ/°C J/°C	
4-11.1	specific heat capacity	J/(kg·K)	kJ/(kg·K)		kJ/(kg·°C) J/(kg·°C)	
4-13.1	entropy	J/K	kJ/K			
4-14.1	specific entropy	J/(kg·K)	kJ/(kg·K)			
4-16.1	specific energy	J/kg	MJ/kg kJ/kg			
4-18.1	specific latent heat	J/kg	MJ/kg kJ/kg			

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
PART V : ELECTRICITY AND MAGNETISM *) **)						
5-1.1	electric current (intensity of electric current)	A (ampere)	kA mA μA nA pA			
5-2.1	electric charge quantity of electricity	C (coulomb)	kC μC nC pC			
5-3.1	volume density of charge, charge density	C/m^3	MC/m^3 kC/m^3	C/mm^3 C/cm^3		
5-4.1	surface density of charge	C/m^2	MC/m^2 kC/m^2	C/mm^2 C/cm^2		
5-5.1	electric field strength	V/m	MV/m kV/m mV/m μV/m	V/mm V/cm		

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* In electricity and magnetism the SI units assume the rationalized form of the equations between the quantities. See ISO/R 31, Part V.

** The IEC has not considered the rules given in this Recommendation, nor the arrangement and the content of the list. In order to give guidance to ISO, IEC/TC 24 has made a list of multiples and sub-multiples used here, but without division into columns.

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-6.1 5-6.2 5-6.3	electric potential and potential difference, tension and electromotive force	V (volt)	MV kV mV μV			
5-7.1	displacement	C/m²	kC/m²	C/cm²		
5-9.1	electric flux, flux of displacement	C	MC kC mC			
5-11.1	capacitance	F (farad)	mF μF nF pF			
5-12.1	permittivity	F/m	μF/m nF/m pF/m			
5-17.2	electric polarization	C/m²	MC/m² kC/m²	C/cm²		
5-18.1	electric dipole moment	C·m				

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-19.1	current density	A/m²	MA/m² kA/m²	A/mm² A/cm²		
5-20.1	linear current density	A/m	kA/m	A/mm A/cm		
5-21.1	magnetic field strength	A/m	kA/m	A/mm A/cm		
5-23.1	magnetic potential difference	A	kA mA			
5-24.1	magnetic flux density, magnetic induction	T (tesla)	mT μT nT			
5-25.1	flux of magnetic induction, magnetic flux	Wb (weber)	mWb			
5-26.1	magnetic vector potential	Wb/m	kWb/m	Wb/mm		

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-27.1 5-27.2	self inductance and mutual inductance	H (henry)	mH µH nH pH			
5-29.1	permeability	H/m	µH/m nH/m			
5-34.1	electromagnetic moment, magnetic moment	$A \cdot m^2$				
5-35.1	magnetization	A/m	kA/m	A/mm		
5-36.1	magnetic polarization	T	mT			
–	magnetic dipole moment	$N \cdot m^2/A$ Wb·m				
5-41.1	resistance	Ω (ohm)	GΩ MΩ kΩ mΩ µΩ			
5-42.1	conductance	Ω^{-1}			kS S (siemens) mS µS	$1\ S = 1\Omega^{-1}$ The name "siemens" and the symbol "S" are adopted by IEC and ISO, but not so far by CGPM.

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-43.1	resistivity	Ω·m	GΩ·m MΩ·m kΩ·m mΩ·m µΩ·m nΩ·m	Ω·cm		$\mu\Omega\cdot\text{cm} = 10^{-8}\,\Omega\cdot\text{m}$ $\frac{\Omega\cdot\text{mm}^2}{\text{m}} = 10^{-6}\,\Omega\cdot\text{m} = \mu\Omega\cdot\text{m}$ are also used.
5-44.1	conductivity	1/(Ω·m)			MS/m kS/m S/m	
5-45.1	reluctance	H^{-1}				
5-46.1	permeance	H				
5-49.1 5-49.2 5-49.3	impedance and modulus of impedance and reactance	Ω	MΩ kΩ mΩ			
5-51.1 5-51.2 5-51.3 5-51.4	admittance and modulus of admittance and susceptance and conductance	Ω^{-1}			kS S mS µS	

(1)	(2)	(3)	(4)	(5)	(6)	(7)
5-52.1	active power	W	TW GW MW kW mW μW nW			
5-53.1	apparent power	VA				See also ISO/R 31, Part V.
5-54.1	reactive power				var	See also ISO/R 31, Part V.
PART VIII : PHYSICAL CHEMISTRY AND MOLECULAR PHYSICS*						
8-3.1	amount of substance				mol** kmol	
8-5.1	molar mass				kg/mol g/mol	
8-6.1	molar volume				m^3/mol $1\ m^3/kmol = 1\ l/mol$	For litre (l) see item 1-5.1.
8-7.1	molar internal energy				J/mol J/kmol	
8-8.1	molar heat capacity				J/(mol·K); J/(mol·°C) J/(kmol·K); J(kmol·°C)	

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* At present Draft ISO Recommendation No. 1777.

** In physical chemistry and molecular physics, the introduction of the additional unit the mole (mol), corresponding to the quantity "amount of substance", is recommended by IUPAP, IUPAC and ISO/TC 12. In this document the mole is not listed in column 3 (SI unit) because it has not so far been approved by the CGPM.

1 mol is an amount of substance of a system which contains as many elementary units as there are carbon atoms in 0.012 kg (exactly) of ^{12}C. The elementary unit must be specified and may be an atom, a molecule, an ion, an electron, etc., or a specified group of such particles.

Item No. in ISO/R 31	Quantity	SI unit	Selection of recommended decimal multiples and sub-multiples of SI unit	Other decimal multiples and sub-multiples of SI unit	Other units or other names of units which may be used	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)
8-9.1	molar entropy				J/(mol·K)	
8-13.1	molarity				kmol/l 1 kmol/m³ = 1 mol/l = 1 mol/dm³ mol/m³	For litre (l) see item 1-5.1.
8-15.1	molality				kmol/kg mol/kg	
8-36.1	diffusion coefficient	m²/s				
8-38.1	thermal diffusion coefficient	m²/s				

THE AMERICAN INSTITUTE OF CHEMISTS,
New York, N.Y., March 22, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, U.S. Senate Committee on Commerce,
Senate Office Building, Washington, D.C.

DEAR SENATOR MAGNUSON: The American Institute of Chemists, a professional association of chemists and chemical engineers, wishes to go on record as favoring the passage of the bill would which direct the Secretary of Commerce to develop and implement a coordinated national plan of metric conversion within the next ten years.

Our entire technology is based on science and scientists communicate via the metric system. Such a conversion would make communication with industry and the public easier. In addition, because the entire world operates on the metric system, communications abroad would be easier.

We feel there is a strong need for a change in the educational program in America's schools to include metrication.

The difficulties that would be encountered in the period of change would be far outweighed by the advantages in the future.

DAVID W. YOUNG.

ELECTRONIC INDUSTRIES ASSOCIATION,
Washington, D.C., April 5, 1972.

Subject: HJR 1092—Metric Conversion.
Hon. DANIEL K. INOUYE,
Senate Commerce Committee,
Washington, D.C.

DEAR SENATOR INOUYE: The member companies of the Electronic Industries Association have studied HJR 1092 and generally support this measure "that would establish a national policy relating to conversion to the metric system in the United States."

The Association's support of this resolution, however, must be tempered with consideration of the following specific comments:

The National Metric Conversion Board

(a) Composition (Section 4): The composition of this Board is extremely important if an equitable and effective program is to be developed. The membership must represent the broad national interests, should not be dominated by government employed or associated personnel, and should have representation from labor, education and industry.

(b) Conversion plan (Section 6): There is some feeling that twelve months is insufficient time for the Board to formulate an equitable and effective conversion plan. An eighteen month period is recommended.

We appreciate this opportunity to offer these recommendations on behalf of the two hundred and thirty member companies of the Association.

Very truly yours,

V. J. ADDUCI.

THE NATIONAL CASH REGISTER CO.,
Dayton, Ohio, April 17, 1972.

Hon. WARREN G. MAGNUSON,
Chairman, U.S. Senate Committee on Commerce,
Washington, D.C.

DEAR SENATOR: I appreciate your sending me copies of current legislation pertaining to metric conversion, and I am pleased that you have placed me on the mailing list to receive future copies of the metric hearings.

I am attaching a copy of our position which was submitted to BEMA regarding specific elements of the Metric Conversion Bill, S. 2483.

We believe that the business community would greet the proposal with more enthusiasm if the Secretary of the Treasury were directed to respond in specific areas such as tax credits with respect to undepreciated capital values or for scrapped inventories.

Sincerely,

R. J. MINDLIN.

Enclosure.

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THE NATIONAL CASH REGISTER CO.,
Dayton, Ohio, April 3, 1972.

Mr. V. E. HENRIQUES,
Director, Data Processing Group, BEMA,
Washington, D.C.

DEAR VICO: The following comments summarize our position in response to the BEMA questionnaire regarding specific elements of the Metric Conversion Bill (S. 2483) introduced at the 92nd Congress.

1. Benefits of conversion

NCR does not feel that new jobs, other than those required for conversion, would be formed due to metric conversion. We don't see a significant improvement in production and, therefore, few new jobs. There would be little economic advantage to our industry by converting to the metric system, and the benefits of conversion would not offset the costs.

We see no reason to revise the BEMA position of a planned program which would allow for more orderly changeover because, as each segment of industry changed over, our use could be planned and predicted.

We also recommend that since BEMA is heavily involved in international standardization of module sizes for standard parts and computer media, which will give the greatest economic advantage regardless of the unit of measure, that specific elements of the Bill which relate to international standardization be dropped since it is covered under a separate bill now before Congress (S. 1798).

2. National policy on conversion

The BEMA position on a planning cycle ranging from 5 to 15 years or more, allowing 5 years for planning and revision of standards, followed by 3 years for design and start-up of products, depending on the product line, is agreeable and that converting to the general use of such system within 10 years from date of enactment is too short a time to be substantially converted to the metric system. The Bill should require proof that voluntary conversion is not possible before requests for new legislation are made.

3. National plan and reporting to Congress

The national plan is to be developed making full use of studies and consultation carried out pursuant to the previous study program as reported on NBS SP 345. The Bill leaves the amount of consultation to the complete discretion of the Commerce Department, and we feel that NBS Metric Advisory Board should continue to support the conversion plan in a coordinative function.

We feel that new legislation as a forcing function should be kept to a minimum and the voluntary phase-out of customary units after a certain date. Metric units should be added to present customary units. Convenience and need will promote voluntary use of dual labeling.

We also feel that the Government should consult with industry in establishing procurement regulations and time scales. If the law provides for public education but does not provide for industry education, we feel that joint expenditure on industry education should be kept to a minimum, and that industry should bear the expenses of conducting its own educational program on metric conversion according to its needs. Minimal Government assistance could be in the form of specialized technical education and training.

We do not feel that reporting of costs and benefits being incurred should be burdened upon industry. It is felt that Government monitoring of conversion program can be accomplished through tax return data had export/import figures.

4. Provisions for company financial assistance

We are in disagreement with the provision in the Bill that tax assistance will only be granted for purchase of equipment manufactured in the U.S. and substantially all of the component parts which are manufactured in the U.S. The industry should retain the option to select their equipment supplier from home or abroad.

New equipment required for carrying out the conversion plan will be required for direct replacement and as a complement to existing equipment. During conversion, dual manufacturing capabilities will be required to supply spare parts in customary units.

We are not in agreement that the Bill make provisions for amending Section 167, Depreciation Guidelines of the Internal Revenue Code of 1954.

The Bill suggests that the tax relief as provided will be later supplemented by the Congress upon recommendations of the Secretary of the Treasury. Thus, the tax relief in the present Bill is limited to personal property manufactured in the United States and substantially all the components of which are manufactured in the United States, and which is placed in service in replacement of other property in order to carry out the requirements of the national plan for metric conversion.

The Bill, as drafted, is hardly one to create enthusiasm in the business community when it fails to address the problem of who pays the cost. We do not doubt that the business community would greet the proposal with more enthusiasm if the Secretary of the Treasury were directed to respond in specific areas such as tax credits with respect to undepreciated capital values or for scrapped inventories.

Sincerely,

R. J. MINDLIN.

DEC 13 1971

BEMA
QUESTIONNAIRE
METRIC CONVERSION BILL
OCTOBER, 1971

On August 6, 1971 Senate Bill S.2483 was introduced to the 92d Congress and cited as "Metric Conversion Act of 1971". As a trade association representing the manufacturers of business equipment we anticipate being called upon to testify during the hearings of this Bill.

The following documents were used in preparation of the Questionnaire. Copies or excerpts are attached for your perusal if you desire.

Senate Bill S.2483 Metric Conversion Act of 1971 (Complete)
NBS 345 A Metric America . . . A Decision Whose Time Has Come (excerpts)
NBS 345-12 The Testimony of National Representative Groups (excerpts)
BEMA Paper -- An Expository Statement of the Current View on Metrication -- August 1970 (Complete)

Background: In accordance with Public Law 90-472 the Commerce Department through the National Bureau of Standards conducted a study of the effects of converting the United States to a metric system. The result of that study was published in a number of documents, the principal one being NBS SP 345 "A Metric America . . . A Decision Whose Time Has Come".

BEMA participated in the study through their Metric Advisory Committee (BEMA/MAC). An expository statement of the "Current Views on Metrication" was prepared by the BEMA/MAC, reviewed by the Policy Boards of the three BEMA groups, and presented at the National Metric Study Conference in August of 1970. "The Testimony of National Representative Groups" published by the National Bureau of Standards as "NBS SP345-12", contains excerpts from the BEMA statement. Inputs for NBS SP345-12 came from over 700 groups including trade associations, labor unions, professional societies and other groups, including consumer activity and public and private educational organizations. The conclusions of the report are in line with the BEMA statement.

The proposed bill S.2483 was formulated around the results of the studies as indicated in the various reports, particularly the one entitled "A Metric America . . . A decision Whose Time Has Come", NBS 345.

In addition to the purpose and title of the Act, the Bill gives a summary of findings which are in line with the National Bureau of Standards findings in NBS 345. In general the Bill provides

(1) that the Secretary of Commerce through the National Bureau of Standards, is to prepare a national plan to convert the United States to the general use of the metric system within 10 years from the date of the enactment of the Bill;

(2) tax assistance in the form of additional depreciation on capital equipment;

(3) small business with additional assistance in the form of loans for equipment; and

(4) that individuals may be given grants for acquiring tools or instruments required by the conversion; and

(5) that public education may be given grants and contracts to assist in training necessary to carry out the plan.

The questionnaire considers the elements of the bill, the background for that element, and provides for your opinion on each question. If you disagree with the particular element of the bill, we ask that you state why you disagree and what you would proposed to do instead. The elements of the bill (paraphrased or quoted) and the questions are in bold face type like this. Background information and BEMA position on metrics are in normal type like this.

First some general questions to identify you, the respondent, and your principal area of concern.

QUESTION 1

(a) This response is from the viewpoint of (check one)
☐ an individual, ☑ a company, ☐ BEMA Committee ________________,
☐ BEMA Council ____.

(b) This response is the opinion of (check one)
☐ an individual, ☐ a group of individuals,
☐ the consensus of the company or organization checked above.

(c) The respondent(s) is interested in the following aspects of the Bill:

				Question
1.	The time schedule for conversion	No ____	Yes ✓	Q-4
2.	Monetary assistance for a company	No ____	Yes ✓	Q-5
3.	Monetary assistance for a small business	No ✓	Yes ____	Q-6
4.	Monetary assistance for an individual	No ✓	Yes ____	Q-7
5.	Monetary assistance for Public education	No ✓	Yes ____	Q-8

Please answer Questions 2 and 3 and those listed after your "yes" check(s) above. All items for which you check "No" will be counted as not applicable.

If part of a question does not concern you, please mark that part "N/A" for Not Applicable.

The lead in on each question quotes from the Bill and gives additional background information to help you understand the subject and BEMA's action to date. If this confuses you and you would rather just make comments on the copy of the Bill and send that instead of the questions, you may do so.

Try a question and see how it goes.

QUESTION 2 – Benefits of Conversion

Under Findings the Bill states that

> "The United States is the only major nation of the world that is not converting to the international metric system"; . . . "the language and tools of our scientific community are already using such system" . . . "the nation is already heading toward such system slowly and haphazardly", . . . "such system is based on fundamental relationships and is easily understood and would be an aid to our educational system".

These statements, we believe, are factual and will require no comment. Other statements of findings are not as evident and may require comment as follows:

> "The Congress finds that the adoption of such system would result in new jobs in the United States."

(a) To what extent do you feel new jobs, other than those required for conversion, would be formed within your organization due to a metric conversion?

None - we do not see improved production and, therefore, few new jobs. Findings are not substantiated in NBS report.

> "The Congress finds that the adoption of such system would enhance our position in world trade markets."

The BEMA position paper included a statement

> "Since a preponderance of nations are tending toward the metric system, it appears to be the system which will be preferred in future international trade."

(b1) Should BEMA retain its present position that conversion to metric system will enhance our world trade markets?

Yes - however, we see little economic advantage to our industry

(b2) Do you import products for domestic sales? Yes

(b3) Do you export products for foreign sales? Yes

> "The Congress finds that benefit of conversion would offset the cost of conversion".

On a national basis this may be true, although it is impossible to access exact benefits or costs for such an involved change; but as an individual organization it may be more practical.

(c1) Would your organization benefit from conversion or not? No - the benefits would probably not offset the cost

(c2) If so in what areas would your company benefit?

(c3) The above answer is based on a study Yes (September 30, 1970)

is intuitive

The Bill states that "The Congress finds that "conversion to such system would be a stimulus to the economy and to new investment in plant equipment."

(d1) To what extent would the conversion increase your sales?

We don't feel that conversion would increase our sales

(d2) Require new investment in plant equipment?

Yes - new equipment required

(d3) The above answer is based on a study Yes (September 30, 1970)

is intuitive

The Bill states "The Congress finds that a common system of measurement would improve international communication."

To the extent that measurements would not have to be converted from one system to another (in international trade, sales brochure and maintenance information) we would as a society benefit by improved international communications.

(e1) Do you have an International Manufacturing Operation? Yes

(e2) To what extent would metric adoption improve technical communication?

Voluntary adoption already proceeding where needed; advantageous for tool interchangeability

The Bill states that "The Congress finds that small businesses and self-employed craftsmen would benefit from a coordinated conversion program."

The BEMA position paper statements included "A planned program generally would allow for more orderly changeover because, as each segment of industry changed over, our use could be planned and predicted. A planned change would probably result in a shorter period of operation in the dual dimensioning mode than would be the case for evolutionary conversion." BEMA therefore recommended a coordinated conversion program.

(f) Do you have any reason to revise this position?

No - (it is debatable that "small business and self-employed
craftsmen would benefit")

Lastly the Bill states "The Congress finds that new international standards are currently being developed into such system and the United States is not fully participating in such development."

The BEMA statement made a strong point of participation in international standards' effort regardless of the measuring system. The BEMA statement includes the following: "The Data Processing segment of our industry is, however, heavily involved in international trade and we, therefore are working through standards organizations to establish module sizes for standard parts and computer media which will give the greatest economic advantage regardless of the unit of measure under which the size was originally established." We further state "Whether or not the United States decides to increase the use of metric units of measure, great emphasis must be placed on continuing compatible module sizes with current equipment."

(g1) Since BEMA is heavily involved in international standardization, should we accept the statement as generally true to the United States?

Yes

(g2) request that it be modified?

(g3) request that it be dropped from the Bill since international standardization is being covered under a separte bill now before Congress?

Yes - prefer that it be dropped from the Bill

QUESTION 3 – National Policy on Conversion

For policy and purpose the bill states "It is therefore declared to be the policy of the Federal Government to adopt as the official and standard system of measurement for the United States the international metric system and to provide for converting to the general use of such system within ten years from the date of enactment of this Act."

The BEMA statement included the following: "It is estimated that a minimum of 8 years, allowing 5 years for planning and revision of standards and 3 years for design and start-up of products, would allow us to be building new designs in a metric system." "The time to redesign all products could vary between 5 and 15 years, and perhaps more depending on the product line." These two statements appear to be substantially in line.

(a1) Do you interpret the intent of the bill as total conversion in 10 years? Yes

(a2) Substantial? No

(a3) Or use of metric in new designs in 10 years?

(b1) Do you feel that 10 years is too short a time to be substantially converted to metric system?

Yes - for certain industries

(b2) Or too long a time?

(b3) What time would you recommend? 15 years

(c) The above answers are based on a study Yes (September 30, 1970)

are intuitive

QUESTION 4 – National Plan and Reporting to Congress

Title 1 of the Bill provides for preparation of a national metric plan and requires that the Secretary of Commerce through the National Bureau of Standards shall within 18 months after the date of enactment of this Act develop and report to the President and the Congress a national plan to carry out the policy stated in Section 3 (a) of this Act. (Sic Statement of policy in Question 2)

The Bill provides that "such plan shall be developed making full use of studies and consultations carried out pursuant to" previous study program as reported in NBS SP 345.

(d1) I have studied the report? Yes

(d2) Scanned the report? -

(d3) Have not seen the report? -

(e1) I agree with the general conclusions? Yes - with some reservation on the findings as they appear on the Bill

(e2) I disagree with the general conclusions?

(e3) Because of the following?

(f1) The above statements are based on factual information which I have? Report of BEMA and NCR input

(f2) Are intuitive?

(f3) Are based on additional information? No

(f4) Please quote additional information or source for it

The Bill provides for "additional consultation with other federal, state and local government agencies and with foreign government and international organizations as may be appropriate."

The statement "such additional consultations . . . as may be appropriate" leaves the amount of consultation to the complete discretion of the Commerce Department.

(g1) Do you agree with this approach? Yes - if consistent current operation

(g2) Would you prefer to see limitations placed on these consultations? No

It further provides that "such plan shall be developed with appropriate participation by representatives of the United States industry, science, engineering, and labor who may be appointed by the President to advisory boards to assist in the development and implementation of a plan." The underlining is editorial comment.

(h1) Should existing NBS Metric Advisory Board be used? Yes - included along with other boards & may act as coordinator

(h2) Do you believe that the Department of Commerce should have complete discretion on the selection of potential appointees?

Yes - with consultation

(h3) Should it have broader powers?

Yes - limited

(h4) If so, what should they be?

To break any deadlocks so as not to hinder or delay implementation of an effective and acceptable plan

Title I further provides that "such plan shall be put into effect to the extent possible under existing law after such 18 month period."

Note this statement makes the law more than one to develop a plan, and in fact requires the implementation of the plan.

(i1) Do you believe this law should activate a ten year conversion period?

No - support BEMA voluntary approach

(i2) Is an 18 months national planning period adequate?

Minimum 24 months

The section further states "and shall include recommendations for any legislation needed to further effect such plan."

The BEMA statement contained the following: "The conversion of standards should, however, be on a voluntary industry by industry basis with government encouragement only. It would be desirable if all sales literature were required to include metric dimensions by a specific date. The gradual elimination of the customary units of measure would probably take place by itself."

(j1) What new legislation would you consider necessary; for example, would it be necessary to require that sales literature include metric units as well as customary units after a certain date?

Metric units added to present customary units first. Secondly, customary units should be removed after 15 years

(j2) Is new legislation required to allow for the dropping of customary units after a specific date?

No - voluntary phase out

(j3) Is new legislation required so that products which we buy be dual labeled for a period of time?

No - convenience will promote voluntary use of dual labelling

(j4) Do you have any suggestions for additional laws that might be required?

(j5) Do you believe that the conversion should not be forced by law? Yes -

- : There must be exceptions made for certain hardships.

Title I also provides "such plan shall include proposed regulations . . . requiring such conversion in activities of the federal government, including procurement, in accordance with an appropriate time schedule."

A further provision authorizes the President to effect these regulations. Reports of federal agencies appear to indicate that they would make the conversion in time with industry conversion and would not attempt themselves to cause the conversion by their procurement practices.

(k1) Do you believe that the Secretary of Commerce should be allowed to propose use of Federal procurement to force a time schedule?

No - this is a Government forcing function

(k2) If industry is to control the schedule, then how would such a schedule be established and maintained?

Federal Government should consult industry in establishing procurement regulations and time scale

Title I further provides that "such plan shall include an appropriate program . . . to educate the public for the purpose of such conversion."

The BEMA statement on this item was "If it is desired to go metric, then the United States government should play a very active roll in educating American industry and the American public on the advantages of doing so. Government should also try to forsee the problems which will arise in the minds of the public and try to make the public more receptive to the changeover period." If the law provides for public education but does not provide for industry education, other than that which industry may procure from public educational institutions under other provisions of the Act,

(l1) Do you believe the statement is acceptable as it stands?

Yes

(l2) If not, then why?

Remember that the conversion would probably require considerable educational effort within the company to train all segments, including marketing, engineering, manufacturing and customer service personnel to the use of new units of measure.

(l3) Should the law include provisions for assistance to industry education as well?

The cost should be borne by industry on voluntary basis. Apprehensive that Government support would involve greater bureaucratic expense

Title I also provides for "such plans which shall include an appropriate program for the provision of technical assistance to industry and labor for the purpose of such conversion."

Technical assistance is rather a broad term and could be used to cover many subjects.

(m1) Do you believe the section is adequate as stated?

No

(m2) Or would you like to see it more specific?

Yes

(m3) If so, what specialized technical assistance would you require?

In the form of technical education and training

Title I provides for reporting as follows: "Not later than two years after such plan is put into effect, and annually thereafter, the Secretary shall report to the President and the Congress with respect to (1) progress being made under such plan; (2) cost and benefit being incurred thereunder; and (3) any additional legislation needed to carry out the policy stated . . ."

If the planning takes 18 months and the first report is two years after such plan, then the first full report to Congress will be after 3½ years, except for recommendations for legislation which could be made during or following the plan phase.

(n1) Is the first required report too late? No

(n2) Too soon? No

(n3) Or is no report required? Reporting expenses borne by Federal Government if necessary

The reporting of "costs and benefits being incurred" could be construed as requiring that industry be required to report separately on its costs and benefits. On the other hand, they could rely on tax return data which could be gathered incidental to another provision of the law, or costs and benefits could be derived from import/export figures since that is where most of the benefit seems to lie.

(p1) Do you feel this provision is adequate as stated?

No - keep reports (special) to a minimum

(p2) Should it be restricted to government costs and benefits?

(p3) derivable from existing reports? Yes

(p4) Have you any additional suggestions? Don't think industry or other groups should be burdened with additional bureaucratic paperwork and reporting. This further increases the cost of conversion. Use Income Tax GNP and export reports

The reporting of requests for "any additional legislation needed to carry out the policy statement . . ." allows for continuing requests from Secretary of Commerce for more legislation.

The BFMA statement asked that "conversion be . . . voluntary industry by industry basis with government encouragement only".

(q) Should the bill require proof that a voluntary conversion is not possible before requests for new legislation are made?

Yes

Provisions for Financial Assistance. Questions 5, 6, 7 and 8 each cover a portion of the four forms of financial assistance provided in the act; namely, (Question 5) income tax assistance on property necessary for metric conversion, (Question 6) Small Business Administration loans to procure equipment, (Question 7) grants to individuals for acquiring tools for instruments necessary to their continued employment, and (Question 8) public education grants.

QUESTION 5 – Provisions for Company Financial Assistance

The proposed Bill amends Section 167 Depreciation Guide Lines of the Internal Revenue Code of 1954 by allowing the taxpayers to use one-half of the useful life normally used. For metal working equipment the normal life would thus be shortened from 12 years to 6 years.

The BEMA paper states, "that to change will require increased capital equipment investment and a possible temporary reduction in plant efficiency.

On the other hand, there is also the possibility that the long range results would be an increase in BEMA companies' productivity because of the new capital equipment."

The proposal provides that tax assistance will only be granted for purchase of equipment manufactured in the United States and substantially all of the component parts of which are manufactured in the United States.

(a1) Do you believe this restriction is desirable? No

(a2) Not desirable? Company to retain option to select supplier at home and abroad

The Bill provides that such equipment must be placed in service in replacement of other property in order to carry out the requirements of the national plan for metric conversion.

In some cases the new machine may not be a replacement on a one-for-one basis but may be required to carry out the conversion plan.

(b1) Is this section acceptable as written?

No

(b2) Should it be broadened to include other than one-for-one replacement?

Yes - retain customary units machine to supply spare parts

(b3) Do you have additional comments?

Replace and complement existing facilities

The Bill allows the Secretary of the Treasury to establish the rules for the election of this special tax writeoff.

(c1) Do you have any suggestions for rules?

Tax write off on Income Tax Value - in excess of present 7 or 10%

(c2) Should your suggestions be written into the Bill or left to the Secretary's discretion?

Yes - our suggestions should be considered by the Secretary, then written into the Bill

The Bill also provides for the Secretary of the Treasury to submit additional recommendations for changes in the Federal income tax laws to Congress. The Bill provides that before submitting recommendations he shall consult with governmental units, private individuals and organizations that he deems desirable.

(d1) Should the Secretary of Treasury be allowed complete freedom on who he consults?

No

(d2) Or should he be required to consult with consumer, labor and trade organizations affected by the proposed change?

Yes

SCIENTIFIC APPARATUS MAKERS ASSOCIATION,
Washington, D.C., May 8, 1972.

SENATE COMMERCE COMMITTEE,
Staff Offices, Old Senate Office Building,
Washington, D.C.

Attention: Mr. Lippek.

Subject: SAMA position on metrication bills

DEAR MR. LIPPEK: We are pleased to submit the enclosed references material to support the scientific instrument industry position in favor of the Administration's Joint Resolution on Metrication. The facts included in our paper prepared for the National Metrication Conference in August, 1970, are still accurate. Our testimony in support of S. 1798 in June, 1971, illustrates the strong relationship between metrication planning and international standards activities.

We would like to make the following additional points which seem particularly pertinent to the forthcoming discussions of metrication by the Senate Commerce Committee:

1. Expanding international trade in technological products points the way to a need for a common measurement language.
2. The need for product harmonization is increasing because more products and parts are being produced in multiple, world-wide locations.
3. Products and systems now on the drawing board will be sold in metric countries when International System (SI) and accepted alternate units become mandatory for commercial transactions in the European Common Market.
4. A timetable has been set for such commercial requirements, and some countries are implementing these regulations with respect to product markings and literature already.
5. The relatively short lifetime of instrumentation products encourages early metrication.
6. The market place is already providing some stimulus for conversion, as indicated above. Financial incentive may be helpful, but should not be critical to the basic decision.

In summary, SAMA supports the thrust of the Joint Resolution, placing high emphasis on the commitment to planned, coordinated national metrication. The mechanism for dealing with changes to engineering standards cannot move effectively until public policy is established.

Sincerely,

JAMES E. FRENCH,
Technical Director.

Enclosures.

SCIENTIFIC APPARATUS MAKERS ASSOCIATION—PRESENTATION TO NATIONAL METRICATION CONFERENCE, AUGUST 18, 1970

GENERAL INFORMATION

Organization: Scientific Apparatus Makers Association, Washington, D.C.
Presentors: Mr. James E. French, Executive Secretary, Scientific Apparatus Makers Association, Washington, D.C. and Mr. H. H. Gorrie, Consultant, Bailey Meter Company, Wickliffe, Ohio, Chairman: SAMA Metrication Task Group.

Nature of the organization

The Scientific Apparatus Makers Association is a voluntary national trade association representing the major segments of the scientific instrument industry. Founded in 1918 to promote a domestic industry which expanded rapidly during World War I, SAMA has worked consistently to assist in the strengthening and expansion of United States production and distribution of scientific and industrial instruments, apparatus and equipment.

SAMA has grown steadily since its founding and now consists of approximately 200 member companies representing the leading firms engaged in the design, manufacture, and distribution of over 40,000 types of instruments, apparatus, reagent chemicals and equipment used in research, measurement, analysis, testing and control by government, industry, education, public utilities, health and medicine. It is conservatively estimated that SAMA members account for more than sixty-five percent of the total business of the industry.

Member companies maintain manufacturing facilities in 31 states, with offices and branches in virtually every state. While these companies employ a total of over 150,000 workers, membership consists primarily of small and medium-size firms of which over fifty percent qualify under the definitions of the Small Business Act. While some member companies are over one hundred years old, the average age of all member companies in the Association is fifty-five years.

At present there are six operating, product-oriented sections in SAMA. They are: Analytical Instrument, Laboratory Apparatus, Measurement and Test Instrument, Optical, Process Measurement and Control, and Scientific Laboratory Furniture and Equipment. The scopes of these groups are identified by the section names. A list of member companies is attached. There are four principal SIC numbers represented among SAMA members. These are 3611, 3811, 3821, and 3831. At the same time this industry is characterized by substantial product diversity. Among the SAMA member companies, 30 additional SIC numbers are represented on a primary or secondary basis.

Participation

One hundred (100) member firms assisted in the preparation of this report. These constitute 57% of the manufacturing members of the Association. All responses supporting this report are based on total sales of participating firms. About 90% of these firms export, with the average percentage of sales abroad being 10%.

PRESENT STATUS

Measurement system usage

The scientific instrument and apparatus industry employs both customary and metric measurement units. By product group nearly all SAMA member firms primarily use customary units, although 45% of responding firms use metric units to some extent. Metric measurement units are traditional in the optical, glassware, and porcelainware sectors of this industry. Additionally certain analytical instruments of European origin have retained design specifications in metric units. Process control manufacturers indicate that their foreign subsidiaries and licenses use metric units.

The majority of reporting firms now conduct all engineering, manufacturing, and marketing operations in customary units. In 1970, for those reporting firms which indicate the use of metric measurement units, the present orientation is more to marketing needs. Fewer firms use metric units in manufacturing and engineering. Thirty-six percent of the firms have projected usage throughout their operations in 1975.

There is an increasing awareness of the need for possible expanded use of metric measurement units in the scientific instrument and apparatus industry. Firms now using, or planning to expand their use, state world market needs, such as increased export potential, compatibility with overseas production facilities, and mating with standard metric parts as principal reasons.

Nearly all movement toward usage of metric measurement units, except in those firms where usage has been traditional practice, has taken place since 1965. Firms in the Analytical Instrument and Process Measurement and Control Sections have plans to reach agreement over measurement units in engineering and manufacturing with foreign affiliates on identical products.

Prior conversion

In engineering and manufacturing operations, 75% of reporting firms are now using decimal inch dimensioning. Significantly more firms use dual dimensioning on drawings than use separate metric drawings. To this extent there is little explicit metric design, except where traditional or required by customer need.

Conversion to metric units, where experienced, has been done by foreign subsidiaries or affiliates. This has caused design differences, non-interchangeability of parts, and differences in performance. Conversion is usually performed at point of manufacture in multi-national firms.

The principal local difficulties experienced by those firms which have, or are anticipating, expanded use of metric measurement units are: training of personnel, need for duplicate drawings, and purchase of metric stock size materials and standard parts. The overall management of tool and capital equipment modification or replacement was frequently cited as an additional problem. The possible problems of increased manufacturing waste, additional inventory, lost domestic sales or conflict with local codes do not appear to be anticipated in this industry.

No sector of this industry has had sufficient experience with conversion or expanded use of metric measurement units to cite specific cost advantages, but 27% predict increased export sales.

Experiences with other countries

Most SAMA firms with foreign affiliates have experienced the impact of the affiliate converting products to metric dimensions, applying foreign codes, and including foreign components. Factual data concerning costs and conversion problems is not available at this writing, but attempts will be made to procure such data for verbal presentation at the conference.

Present and past effects of increasing metric usage

Most companies with international operations have encountered difficulties in establishing and maintaining identical product lines between parent firms and foreign affiliate organizations. The Analytical Instrument and Process Measurement and Control Section members are particularly concerned about two aspects of world metrication, although the impact thus far in these areas has been minimal.

(1) Germany is very aggressive in the promotion of standards based on metric measurement units. It is evident that intensive effort is required to assure that U.S. products are not excluded from world markets by national standards since many countries are adopting the German proposals.

(2) The emerging markets for instrumentation and control are South America, India, Africa, and the Far East. These countries, being committed to metric measurement, are more difficult to exploit in the face of German and Japanese competition.

POSSIBLE FUTURE EFFECTS

Evolutionary metrication

For the scientific instrument and apparatus industry evolutionary metrication will be slow as long as technological leadership is maintained. Voluntary conversion will be planned by individual firms as economic necessity indicates the value of the investment. For those firms with world markets or international operations, pressure to metricate is much more likely than for those firms with purely domestic operations and markets. Barring intense customer demand or obvious internal savings, many firms in this industry will delay voluntary metrication as long as possible.

Some firms depend on technological superiority for market penetration. These companies have been relying on performance specification for sales and have not designed their products in metric measure, but provide adaptors or custom accessories where needed. A survey of the Analytical Instrument and Process Measurement and Control member firms indicates that these companies are planning to metricate on a new-product-release basis to combat the factors cited above.

Planned metrication

The impact of a planned program will vary with the member companies represented by each section of SAMA.

Optical.—The member companies of this section are manufacturing optical elements to metric measurements now; however, mechanical elements are made in customary units. A national metrication program can be beneficial to them because of the greater availability of metric components.

Analytical Instrument and Process Measurement & Control.—Since the member companies in these sections are in the process of committing themselves to an "optimum time period" for metrication, a planned program will assist in this effort. Its impact will be to reduce costs because standards, materials, and purchased components will be available on a shorter time table. The reporting process control companies include five makers of automated control values. These firms are much more responsive to manufacturing codes than firms which are primarily process instrument manufacturers. They tend to export less, feel the metrication impact less, and will undertake conversion programs less readily.

Scientific Laboratory Furniture & Equipment.—On the other end of the scale, the member companies in the Scientific Laboratory Furniture and Equipment Section have nothing to gain from metrication because their products are essentially built to local codes and for local markets. Either program represents added costs with no apparent economic return.

Laboratory Apparatus and Measurement & Test Instrument.—These companies will feel the impact midway between that of the Analytical Instrument and Process Measurement and Control on the one side and the Scientific Laboratory Furniture and Equipment manufacturers on the other side. Although a substantial number of firms in these sections use the metric system to some extent, it is more often for a primary product, market preference, or historical reason than by plan. Typically 20% of these firms have overseas operations and are currently being exposed internally to the effects of expanded worldwide use of the metric system. Nearly all of these firms with overseas operations do conduct their manufacturing and services in such establishments in metric units. Most of these firms prefer to gear their plans to the U.S. national trend.

Engineering standards

The scientific instrument and apparatus industry must comply with the applicable engineering standards of all industries which it supplies. At the same time, with the exception of those standards developed for instrumentation, e. g. case dimensions, signal ranges, and nomenclature; SAMA member companies cannot accelerate or impede progress in standards development. The instrument industry may be considered as an ancillary or service group to all the process and power industries.

Wherever process industry standards, such as the piping code, unfired pressure vessel code, boiler code, and electrical code are accepted by industry, or state regulatory bodies, the instrument industry must comply. This means the instrument industry cannot complete its metrication program until all the industries which it supplies have completed their programs.

This is not as ominous as it sounds because in practically every case metric measurements can be adapted to the codes. The last impact remains, however, since metrication for the scientific instrument and apparatus industry could be a 2 or 3 phase program to match standards or code development.

Other cost predictions

As indicated above, 27% of responding firms stated that they expect increased exports if they substantially convert to metric measurement units in their operations. Ten percent also anticipate greater competition from imports if all products are available in the same system of measurement units, while 3% indicate a decrease in this aspect. Not surprisingly 73% predict no effect on exports and 87% see no inroad in the domestic market. These figures verify the high degree of uncertainty about metrication which exists in the scientific instrument and apparatus industry. The cost of conversion, either evolutionary or planned, will be a large investment, and the payout period is not predictable.

CONCLUSIONS

In general this industry believes the United States should metricate to remain competitive in the world market. SAMA members are classified by economic interest in this problem above.

Three basic problems confront the scientific instrument industry in analyzing possible metrication programs: (a) Raw material sizes; (b) Fasteners; (c) Regulatory Codes.

In the case of (a) and (b) some form of investment credit or tax relief could accelerate the availability of these materials thereby accelerating the entire conversion program and reducing the total cost of being out-of-phase with availability of essential materials.

In the case of (c) this industry is handicapped by antitrust regulations if it attempts to coordinate accelerated changes in codes and standards, either domestic or international. Governmental assistance is needed here to complete metrication in anything like 10 years.

Multi-national companies have and will continue to metricate as necessary by product line at a rate that is economically acceptable. For these companies U.S. metrication will help relieve the international dual system confusion. On the other hand, companies which concentrate on domestic markets will tend to continue to use customary units until economic factors favor metric usage.

STATEMENT OF WILLIAM E. VANNAH IN BEHALF OF SCIENTIFIC APPARATUS MAKERS ASSOCIATION

Mr. Chairman and Members of the Subcommittee: I am William E. Vannah, Manager of Corporate Programs for the Foxboro Company of Foxboro, Massachusetts. I am appearing on behalf of the Scientific Apparatus Makers Association, 1140 Connecticut Avenue, N.W., Washington, D.C. I serve as Chairman of the Standardization Committee of this Association.

I. THE INDUSTRY AND ITS ASSOCIATION

The Scientific Apparatus Makers Association (SAMA) is a national trade association and is the principal association for the scientific, industrial, and laboratory instruments industry. SAMA has a membership of approximately 200 American firms. The product scope includes analytical instruments, laboratory apparatus, measurement & test instruments, optical instruments, process measurement & control instruments, and scientific laboratory furniture & equipment. Markets for this industry are manufacturing firms, government, educational institutions, research and development establishments, and health care facilities. The total annual sales for the industry are approximately $3.0 billion. SAMA represents approximately $2.0 billion of this total.

The export market is very important to the SAMA companies. The Commerce Department has identified our industry as one of the six American industries with the greatest potential for export growth based on recent performance and technological leadership. Export sales account for about 25% of our total business and the individual company range extends from 10% to as high as 50% for some firms. This export achievement, which is largely the result of our technological leadership and marketing aggressiveness, has not only benefited our industry but has also made an important contribution toward improving our national balance of payments position. In 1970 United States exports of our products exceeded imports by a ratio of 3.8 to 1. However, the international market in our product has been highly competitive and our foreign competitors are rapidly improving their products and intensifying their marketing efforts in both this country and in the international market. The maintenance of this favorable position in international trade is dependent upon technological competition in which international standards is an inherent part.

II. THE IMPACT OF INTERNATIONAL STANDARDS

The National Bureau of Standards has issued a preliminary report on international standards as part of the U.S. Metric Study (NBS SP 345–1, December 1970). In this report scientific, industrial, and laboratory instruments are considered to be "measurement-standards sensitive." This means that the design, manufacture, marketing, and use of these products is affected by standards of measurement language, dimension, calibration, or test. NBS estimates that 30% of U.S. exports should be considered in this class. The favorable balance of trade is 3 to 1 for products which are measurement-standards sensitive, while it is approximately even for the total of all U.S. products. The importance of measurement-standards sensitive products in relation to the U.S. position in international trade is apparent. A national awareness of the effects which international standards have on international trade is vitally necessary. Only in this way can maintenance of the United States' trade leadership in standards-sensitive products be assured.

Measurement standards affect international trade in several ways, some more by plan than others. Control of the effects on U.S. trade requires participation in all of the endeavors which develop and utilize international standards. The United States has been represented in international standards activities by a thin line of industry volunteers in recent years. The Federal Government must also play a role in U.S. participation, principally because the national governments of all other developed countries do so extensively.

The metric system is a measurement language standard. Increasing world-wide use of this standard appears to be affecting trade. Standards-sensitive products are more likely to be affected by use of the metric system than other products. The importance of the metric system in international trade is attested to in a SAMA position paper presented at the NBS Metric Study Conference held in August 1970. In this paper we stated that as many as 50% of our member companies were already using some metric measurement to meet this challenge.

NBS has further indicated that the two major voluntary international standards writing organizations, the International Standards Organization (ISO) and the International Electrotechnical Commission (IEC), expect to triple their production of engineering and commodity standards every five years. Increasingly, both developed and developing nations are adopting international recommendations as their national standards. These two facts alone indicate a strong need for Federally-assisted U.S. participation in international standards deliberations. The greatest impact on international trade will increasingly occur as international product testing programs based on international standards are adopted. These product testing programs are most likely to involve standards-sensitive products.

Unilateral codes and standards frequently have the effect of non-tariff trade restrictions. The use of standards as a non-tariff barrier is a common practice of nations abroad which have developed an instrument design capability. To compete successfully in such markets, the SAMA company is forced to:

(1) attempt to marshall the efforts of the USA and associated nations to write international recommended standards that accommodate the many unilateral national standards. During the extensive time taken, the bias to open competition persists; and

(2) vary product design for each unilateral code and standard. SAMA companies follow this practice to keep a market open when there is insufficient time to negotiate non-discriminatory standards. The result is the manufacture of multiple designs, consequent loss of high-volume production, and consequent higher costs. Specific examples where bias has affected U.S. instrument manufacturers are:

Color coding of wires.—USA had a standard for the uniform color coding of live and ground wires in electrical equipment. European nations suddenly adopted a different color coding. To fill European orders for U.S. designed test instruments and process control instruments, the wiring had to be replaced and subsequent designs changed. This was a particular burden for small U.S. manufacturers.

Industrial plants transmitters.—U.S. designed industrial plant transmitters had operated on a standard electrical current range. Without sufficient participation by the U.S., European nations recently agreed to a different standard. The European market was quickly closed to U.S. manufacturers. Recovery of our market position required a redesign and associated retooling.

SAMA considers that the development of internationally pervasive standards and the negotiated agreements for compliance to these standards are essential. For small and large manufacturers alike they are a fair method of eliminating biases to open competition.

III. SAMA AND THE INDUSTRY RESPONSE

On behalf of its industry SAMA has provided U.S. representation regularly during the past 11 years to help overcome the kinds of bias to competition described above. Delegates to international standards meetings related to instrumentation have come from user organizations, as well as from instrument manufacturers. Support for travel of delegates to international meetings has been provided by both the industry collectively through SAMA and by individual firms. The attached table summarizes this activity.

When U.S. delegates participate in international standards activities on a long-term technical basis, our experience has been that multilateral negotiations with other nations are sound and constructive. However, our industry is increasingly faced with international standards activities which cause commercial crises. These situations force crash responses by U.S. industry. This action tends to be costly and ineffective.

IV. FUTURE NEEDS

The Scientific Apparatus Makers Association believes that the United States is capable of protecting our international trade position in the instrumentation field in light of challenges offered to it by international standards activities. From the standpoint of the scientific, industrial and laboratory instruments industry, four factors are essential to the overall goal of sustaining the U.S. trade position. These are: (1) continuity of representation; (2) addition of more user and government representatives to U.S. delegations; (3) joint industry-government accreditation of delegates; and (4) adoption of an international standards compliance system.

Continuity of representation is important to assure that qualified delegates gain professional acceptance. It also provides consistency in the U.S. technical position. Continuity of representation is as important as the technical and negotiating capabilities of the official delegates.

In many international standards activities related to the instrument industry, considerable talent is found among user firms and government agencies. However user organizations as well as the government have been reluctant to take initiative in international standards activities. Additional user and government representation is required to achieve the most effective participaton by the USA.

International standards organizations require that national delegates be accredited by recognized organizations in their home countries. Such accrediting organizations in other countries are officially recognized by their respective governments. U.S. delegates, while accredited, lack such government endorsement.

Other nations are beginning to use the results of standardization activities in other than voluntary ways. International recommendations are being adopted as national standards throughout the world. These documents form the basis for international standards compliance systems to which products must conform in order to be sold in the adopting countries. Such systems constitute non-tariff trade barriers to U.S. products when U.S. standards are not compatible with the system.

SAMA believes that the U.S. must develop a capability to participate in international standards systems. A U.S. plan for voluntary standards compliance is necessary for acceptance and effective operation internationally. SAMA feels that international standards systems will be directed increasingly toward standards-sensitive products. Because our trade leadership is highly dependent on these products, urgent consideration should be given to national support for this aspect of the challenge.

V. RECOMMENDATIONS AND CONCLUSIONS

The Scientific Apparatus Makers Association supports and urges the adoption of S. 1798 the "International Voluntary Standards Cooperation Act of 1971." We believe that this legislation can provide the basis for more effective U.S. participation in international standards activities and system. The enactment of this legislation can assist significantly in consolidating U.S. positions for international engineering and commodity standards. The support of U.S. delegates in international standards activities, strengthened by the implementation of standards systems in the United States, will help maintain a favorable U.S. balance in international trade. A U.S. standards program based on participation bp producers, users, and government will assure the technical soundness which has long characterized American engineering and commodity standards. Such a program would provide the needed national focus to safeguard against the unfavorable impact of international standards in U.S. world trade.

Thank you very much, Mr. Chairman, for permitting me to appear here today and for the courtesies extended by you and your staff.

SUMMARY OF SAMA ACTIVITY IN INTERNATIONAL STANDARDS

PRODUCT AREA AND TYPE OF ACTIVITY

Laboratory glassware & thermometers (ISO TC48), began 1960.
1. Sponsor U.S. committee.
2. Formulate U.S. positions.
3. Support delegate travel.
4. Propose industry standards as international recommendations.
5. Sponsor ISO Recommendations as industry standards.

Intrinsically safe instruments (IEC TC31), began 1965.
1. Formulate U.S. position.
2. Support U.S. delegates.

Fluid flow measurement (ISO TC30), began 1967.
1. Support U.S. delegates.
2. Host international meeting in U.S.

Process control systems (IEC TC65), began 1968.
1. Formulate U.S. position.
2. Support U.S. delegates.
3. Host international meeting in U.S.
4. Sponsor working group secretariat.

Industrial process control instruments (ISO TC124), began 1968.
1. Formulate U.S. position.

2. Support U.S. delegates.

Electronic measuring instruments (IEC TC66), began 1968.

1. Support U.S. delegates.
2. Sponsor subcommittee secretariat.
3. Formulate U.S. positions.
4. Host international meeting in U.S.

Electrical reference instruments (IEC TC13), began 1969.

1. Comment on international proposals.
2. Support U.S. delegates.
3. Sponsor IEC Recommendations as American National Standards.

Process control instrument dimensions (IEC TC13), began 1970.

1. Formulate U.S. position.
2. Support U.S. delegate.
3. Organize user supported U.S. position.

Pollution instrumentation (proposed in IEC TC66), began 1971.

1. Sponsor working group secretariat.
2. Support U.S. delegates.
3. Formulate U.S. positions.

NOTE: ISO=International Standards Organization. IEC=International Electrotechnical Commission.

NATIONAL SCIENCE TEACHERS ASSOCIATION,
Washington, D.C., June 7, 1972.

Hon. WARREN G. MAGNUSON,
Senate Commerce Committee,
U.S. Senate,
Washington, D.C.

DEAR SENATOR MAGNUSON: At a meeting of the Board of Directors of the National Science Teachers Association in New York City on April 10, the Board adopted the following statement in regard to Congressional action relative to conversion to the metric system of measurements. We respectfully urge the Congress to pass the Metric Conversion Act at an early date.

The Board of Directors of the National Science Teachers Association supports passage of S. 2483, the Metric Conversion Act of 1971, and urges early and favorable action on this bill. Transition to the metric system is desirable and inevitable and is already underway in a fragmented and uneven manner. A national well-scheduled change over, such as is proposed in S. 2483, will assure timely education programs in preparation for metrication and the smooth functioning of all segments of our society as the United States joins the rest of the world in the use of the metric system of measurements as its official standards.

We wish also to assure the Congress that this Association is ready and eager to engage in educational efforts designed to increase the use of the metric system within our own field and to assist in the educational programs for the general public. Such activities are already under way in the Association in anticipation of wider and—we hope, official use of the metric system.

If we can be of any assistance to your committee in its deliberations, please call upon us.

Sincerely yours,

MORRIS R. LERNER, *President.*

STATEMENT OF THE AMERICAN IRON AND STEEL INSTITUTE

Mr. Chairman and members of the Committee on Commerce, this statement is submitted on behalf of the American Iron and Steel Institute, a non-profit trade association with 66 member companies in the United States. These companies account for more than 95% of this country's steel production, and employ well over 500,000 hourly and salaried workers. We welcome the opportunity to present our views on S. 2483 because of the effect that such legislation would have on our industry.

This statement is the result of a study conducted over a period of two years on the impact on our industry of a change in our measurement system and dimensions from the customary units to the metric system. The views expressed herein represent the consensus of the steel industry.

BACKGROUND

We have made careful studies of the advantages and disadvantages to our industry, should we convert our system of measurement, engineering technology, and dimensions of our products to the metric system. While scientists are concerned with varying forms of measurement and calculation, our industry and other industries must consider the dimensions of our products as suitable to fit existing machinery. Thus the advantages or disadvantages of varying methods of measurement must be considered as they affect our total business.

With the exception of some work in our research laboratories, all of our dimensioning, design, engineering calculations and dimensions of product are in customary units. With ninety-five percent or more of our products being made for consumption in the United States or Canada, we furnish our products to fit the machinery or designs of the North American continent which use customary units. We furnish steel products to most countries of the world and if industry in these countries have metric dimensional requirements, we furnish to their sizes, and our paper work and literature is in their languages. In getting business in any country, we have found through long experience that price, performance, design and availability are the determining factors, rather than the system of measurement used. Accordingly, we believe there is no compelling reason for the steel industry and many other important American industries to incur the exorbitant costs of conversion to the metric system which might affect only a minor fraction of our business. Actually, such a change nationally will further disadvantage many American industries, including the steel industry, facilitating access of foreign industries in metric countries to U.S. markets, increasing their penetration of our markets, without our obtaining corresponding increases in their markets.

POSITION

At this time, the domestic steel industry will derive no significant advantage in shifting to the metric system. It is the opinion of the industry that the change in system would produce no increase in sales of our products. It is recognized, however, that as suppliers of standard materials the member companies of the American Iron and Steel Institute must respond to the demands of customers who may order in metric units and sizes. It is recognized that the industry may be required to adopt the metric system for reasons of national interest not primarily concerned with the steel industry.

COSTS

A. *Cost of developing standards.*—A decision requiring the steel industry to change to the metric system would present an immediate need for a review of all presently available steel mill product standards, for such revisions of these standards as indicated, and for the development of new standards as necessary. The Institute believes that the greatest and most adverse cost impact would occur if inadequate new standards were adopted in the haste to get the job done. Moreover, increased activity in standards writing bodies would create additional costs, by placing added demand on the technical personnel of many industries, including those of the steel industry.

B. *Cost of premature replacement of capital equipment.*—It can be clearly demonstrated that a policy of replacing capital equipment with new equipment of metric design, prior to the normal time of replacement (up to 40 years) through wear-out or obsolescence would be so expensive that consideration of such a policy must be quickly abandoned. On the other hand, replacement of equipment on a normal schedule, if required, still entails added costs. Such added cost would be directly attributable to the annual expenditures required to maintain and operate two types of equipment, of metric design and of customary design, during the conversion period.

C. *One-time costs of conversion.*—One-time costs would be incurred during the period provided to develop the capability and prepare for conversion to the metric system. These would include but would not be limited to changes in record keeping systems, purchases of jigs, fixtures, measuring devices and training personnel. The cost for the steel industry is estimated to be approximately $785 million. This assumes there will be sufficient time available for purchases, training and adequate planning preceding start of conversion. The greatest adverse cost impact in this area would be attributable to damage to equipment and loss of material at various stages of production, due to hasty and inadequate planning of the conversion, and training of personnel.

D. *Recurring annual costs.*—Studies have indicated that the steel industry, as a supplier of standard materials, would have little control over its rate of going metric, should the nation decide to go metric. If customers should adopt widely differing plans, rates, and times for going metric, the effect on the steel industry would be profound. We would be faced with a prolonged and indefinite period of carrying parallel systems of describing product, selling, pricing, ordering, scheduling, weighing, shipping, testing, stocking, duplicate instrumentation, etc. Our estimates indicate that the recurring costs of converting to metric over the 10-year conversion period is 1.376 billion dollars.

E. *Costs summary.*—The combined one-time costs as discussed in C above and the continuing costs over the 10-year conversion period as discussed in D above amount to 2.161 billion dollars. These estimates are based on wage rates and prices in effect in 1971. These costs apply to the steel industry Standard Industrial Classification Code 3312 which is blast furnaces (including coke ovens) steel works and rolling and finishing mills. Full cost impact to convert to the metric system for mining, transportation, fabrication and other related activities has not been included since the studies by the Commerce Department were formulated on a standard industrial classification code basis.

RECOMMENDATIONS

We have briefly set forth the position of the steel industry concerning proposed legislation authorizing a shift to the metric system. As we have indicated, the domestic steel industry will derive no significant advantage in adopting the metric system.

Because of the staggering costs involved in conversion to the metric system (estimated in some studies to be as high as 60 billion dollars) with little or no benefit emanating from such conversion, we urge that should conversion prove necessary, some form of tax relief or tax incentive be accorded to American industry to make the conversion feasible.

STATEMENT OF THE NATIONAL EDUCATION ASSOCIATION

The National Education Association is pleased to support S. 2483, providing for a national program to make the international metric system the official and standard system of measurement in the United States within ten years. Append is the position paper of the National Education Association which is published as Appendix II of substudy 6 of the U.S. Metric Study (NBS SP345-6, *U.S. Metric Study, Interim Report: Education*). This position paper reviews the interest expressed by the NEA more than a century ago and cites the resolutions adopted by the Association beginning in 1968 which actively support a national conversion to the metric system. Also appended is the 1971 NEA resolution which endorses a ten-year period of conversion to the metric system and encourages teachers to take immediate steps to prepare to teach the metric system as the primary system of measurement by 1973–74.

The NEA accepts the validity of the reasons supporting a decision for the United States to convert to the international system of measurement. This statement will not repeat these arguments. Rather, we will discuss the desirability of a ten-year period for the conversion and the necessity for an established deadline for this conversion through our society.

NEEDS FOR A 10-YEAR PERIOD TO CONVERT

The NEA supports the plan for a ten-year conversion because an abrupt change would not be desirable even if it were possible. In a sample survey of public school teachers during the 1970–71 school session, only 42.8 percent responded affirmatively to the following question: "Do you believe the United States should move promptly to the use of the metric system as the primary system of weights and measures?" While only one-third of the elementary school teachers in the sample approved prompt conversion (36.4 percent), the secondary school teachers were divided equally on this question with 49.8 percent responding affirmatively (*NEA Research Bulletin*, December, 1971, page 110).

One of the reasons many teachers do not favor immediate conversion is that they themselves do not fully understand the metric system. In response to the question: "Do you believe you yourself are sufficiently knowledgeable about the metric system to make the transition from the present English system of weights and measures?" only 35.2 percent of the same of public school teachers responded affirmatively. More than two-fifths of the secondary school teachers (44.2 percent) and about one-fourth of the elementary school teachers (26.9 percent) give an affirmative response (ibid. page 112).

The ten-year conversion period will provide time for elementary school teachers to become fully familiar with the metric system, to experiment with ways of teaching it, to develop learning programs and resources, and to identify various resources needed for effectively teaching the metric system. Also, this period will provide an opportunity for teachers of all subjects and grades to become sufficiently familiar with the metric system to allow them to integrate this system of measurement into their instruction. It is likely that a rather high proportion of mathematics and science teachers already are prepared to deal with the metric system as the primary system of measurement. As the national program for conversion leads to increasingly widespread use of metric units in consumer goods, the student's learning of the metric system will be reinforced more effectively in a variety of subjects such as home economics, industrial arts, business education, distributive education, and in vocational-technical subjects.

The 1971 NEA resolution which supports national conversion to the metric system also proposes an initial 2-year period during which teachers will become prepared to teach the metric system effectively, and that following this period the metric system would be taught as the primary system of measurement.

NEED FOR A SPECIFIED DATE FOR COMPLETION OF NATIONAL CONVERSION

The NEA supports the provision of a specific terminal date for the conversion period because this will assure legal support for the change which will be made in school curricula. Many public school teachers will be reluctant to make the necessary change of instructional emphasis unless the final date for national conversion is established as national law.

Conversion to the metric system as the *primary* system of measurement requires that the teacher assist the student to perceive his world in metric instead of traditional units, and he will teach the student to solve measurement problems in metric units instead of traditional units. This change will help the student to *think* in metric units, a process which is considerably different from thinking in traditional units. The teacher must have the support of a national law which assures that this change is appropriate, timely, relevant, and consistent with changes throughout our society.

NEA IS PROMOTING READINESS FOR CONVERSION

The Board of Directors of the NEA has established an Ad Hoc Committee from its members to provide leadership and direction to the Association's efforts to assure smooth conversion to the metric system as the primary system of measurement during the next ten years. One of this committee's first objectives is to help teachers to better understand the metric system and to become aware of the instructional materials which may be used to teach it effectively.

SECTION 203

The Association supports Section 203 of S. 2483 because this provision should assist state and local school systems to begin immediate planning to develop programs leading to the conversion. The Association would recommend that the level of financial support be set at 100 percent of the cost of the programs approved during the first three years of the ten-year conversion period, and that it be at least 50 percent of the cost of the programs approved during the remaining seven years. The graduated scale of support will encourage immediate development of the necessary educational programs leading to complete conversion to the metric system within the ten-year period.

The National Education Association endorses S. 2483 and offers its wholehearted support to the implementation of this and other legislation leading to the general use of the metric system in the United States within the next ten years.

1971 NEA RESOLUTION

C-16. CONVERSION TO THE METRIC SYSTEM

The National Education Association believes that a carefully planned effort to convert to the metric system is essential to the future of American industrial and technological development and to the evolution of effective world communication. It supports federal legislation that would facilitate such a conversion.

The Association declares that teachers of all grades should teach the metric system as the preferred system of weights and measures of the United States, and beginning in 1973–74, should teach the metric system with greater emphasis to assure, as a national goal, the orderly transition to the use of the metric system as a primary system by 1980. (69, 70, 71)

THE EDUCATIONAL IMPLICATIONS OF METRICATION

The interest of the National Education Association in the adoption of metric measurement is not of recent origin. A century ago a few distinguished members of the Association were advocating adoption of the metric system of weights and measures in the United States. And through the years many members have continued to support that position, especially some of the profession's foremost teachers of mathematics and science and some administrators and curriculum specialists concerned with program development.

The interest shown by teachers has by no means been universal and, except on the part of a few crusaders, has not been militantly agressive. Educators for the most part have believed that metric standards of measurement are superior to those in use and that *if adopted in the United States* it would be easier and less time consuming to teach the metric system. But few have regarded it as their duty to press for a change in public policy on this matter. Many have had teaching responsibilities which seldom involved the application or interpretation of measurement devices. Many educators as well as others, accustomed as they were to existing standards, were indifferent toward, or actually fearful of, any proposed change even if they would admit that *theoretically* there were many advantages.

For such reasons it is only in recent years that the voice of teachers on the subject of metrication has been heard, from greater numbers and in more insistent tones.

Association Interest a Century Ago

The National Education Association was only 12 years old when in 1869 it created a Committee on Coins, Weights, and Measures, with Charles L. Davis of West Point as chairman. In his report to the Association, at the convention in Cleveland in 1870. Dr. Davis referred to his work on a similar committee of college educators which recently had presented a report and recommendations to another organization in Albany. His report, which he said was identical to that made in Albany, carried seven recommendations to NEA:

(1) That the Association continue to provide for intensive study of planned metrication—"all its bearings and all its consequences";

(2) That the Committee be authorized to include as a part of its printed report the statement made to the House of Representatives by John Quincy Adams in 1821 and a lecture by Sir John Herschell on "The Yard, the Pendulum, and the Meter";

(3) That all teachers be urged by the Association "to give special attention and study to this subject";

(4) That England, France, and the United States should be urged to make certain changes in the then existing values of the Pound, Franc, and Dollar and at the same time to fix a permanent ratio for them;

(5) That the Committee be authorized to carry on correspondence and otherwise promote its recommendations;

(6) That authors and publishers of textbooks for elementary arithmetic be urged to "exclude from future editions every currency not recognized and established by law"; and

(7) That the Committee be authorized to "ask the attention of the Government, and of all the associations for the advancement of science and knowledge, to the expedience of changing the value of the ounce Troy, and thus substituting a single weight for the three now in use."

Association records do not show what follow-up was made on this report either by the Committee or by association officers. Its significance lies in the fact that one hundred years ago, in 1870, change to metric standards of measurement was of sufficient interest and concern to educators that NEA created a special committee on the matter and heard its report at an annual convention.

Opinions of Distinguished Educators and Other Eminent Persons

From time to time professional educators acclaimed as leaders by their contemporaries have spoken out on behalf of conversion to metric standards. In 1880 the eminent superintendent of schools in Worcester, Massachusetts, Dr. Albert P. Marble, had this favorable comment but realistic forecast about the adoption of metric measurement:

> The metric system is very simple. Its introduction at once would be a great saving of time and money. But it will not at once be introduced. How was it with the decimal system of money? It was a century be-

> fore four-pence-ha-pennies and nine-pences disappeared from general circulation; and then they would not have disappeared but for the war. To apply the decimal system to these reforms [weights and measures]: The metric system will not become general in less than 100 years.[1]

The U.S. Commissioner of Education in 1944, John W. Studebaker, stated in the magazine *This Week:*

> The universal adoption of the metric system of weights and measures would pose no great difficulties for the schools. Indeed, if the schools were to teach only the relatively simple metric system the task of teachers and of students would be immeasurably lightened.[2]

Similarly in 1946 the long-time editor of the *NEA Journal* wrote:

> I am thoroughly in favor of the widest possible use of the metric system in education, industry, and everyday life. It is scientific, logical, and easy to use and furnishes a necessary base for international cooperation in science and industry. The use of the metric system throughout our life, based on a thorough teaching of the system in our schools, would be a great advantage. It would simplify the work of education. Children are confused and delayed in their learning by the miscellaneous and clumsy tables that have grown up in our English and American usage. If we will substitute the metric system, children must be brought to understand not only the system itself which is relatively simple but also the difficulties of making the change from present measures over to the metric scheme and the great advantage of making that change.[3]

Thomas Edison, Alexander Graham Bell, and George Westinghouse all were strong advocates of the metric system. So, too, was Andrew Carnegie, who said, "The present weights and measures of the United States of America are unworthy of an intelligent nation today."[4] Likewise, Arthur J. Balfour, noted in 1895 that, "Upon the merits of the case I think there can be no doubt. The judgment of the whole civilized world has long decided that the metric system is the only rational system."[5] In similar statements all through the years prominent educators and other leading citizens have in effect concurred in R. H. Pray's indictment in which he said, "The people in the United States have relegated themselves to one technological *last!*"[6]

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[1] National Education Association. *Addresses and Proceedings.* Washington, D.C.: the Association, 1880. vol., p. 39.

[2] Studebaker, John W., *This Week.* April 16, 1944.

[3] Quoted in the Twentieth Yearbook of the National Council of Teachers of Mathematics. *The Metric System of Weights and Measures.* N.Y. Bur. of Publications, Teachers College, Columbia University, 1948. p. 57.

[4] *Ibid.*; p. 118.

[5] *Ibid.*; p. 118.

[6] Pray, R. H., "The Metric System is Simple." Arithmetic Teacher 8: 179. April 1961.

Significant Action by Various Educational Groups

Many associations of teachers whose work is directly concerned with the development of understandings and skills in the use of measurement standards have gone on record, at one time or another, in favor of planned metrication. Typical of such action are the following resolutions:

American Association for the Advancement of Science. (Adopted by the Council, December 29, 1922.)

Whereas, the metric system of weights and measures has not yet been brought into general use in the United States, and

Whereas, the American Association for the Advancement of Science has already adopted and published resolutions favoring the adoption of the metric system of weights and measures in the United States;

Therefore be it resolved, that the American Association for the Advancement of Science reaffirms its belief in the desirability of the adoption of the metric system of weights and measures for the United States, and recommends that units of that system be used by scientific men in all their publications, either exclusively or else with the customary non-metric units in parentheses.

Central Association of Science and Mathematics Teachers. (Adopted in Chicago, November 25, 1944.)

Whereas, the advantages of the metric system, well known to scientists and mathematicians, would be in harmony with the simplification procedures which will be a part of the post-war reconstruction program, and

Whereas, the metric system reduces all necessary computation in measurement to the operations of whole numbers, thereby greatly simplifying the learning of arithmetic by children, and

Whereas, there has been a long steady trend in metric adoption by 55 of the 57 countries of the world, and

Whereas, there is no probability among the nations now on a metric basis of going back to the English system, thus necessitating the use of two systems with the accompanying inconvenient and time-consuming inter-conversions instead of one simple system, and

Whereas, the close of this war will furnish an opportunity never before presented, when customs and habits have been torn loose from their ruts;

Therefore be it resolved, that the Central Association of Science and Mathematics Teachers go on record as favoring some form of legislation for immediate metric usage in those lines most feasible for metric adoption.

National Science Teachers Association. (Adopted at Pittsburgh, July 4, 1944, as the Association's first item of business.)

Whereas, the present practice in the United States involves the use of many and various methods of measurements which in total are a conglomeration which is cumbersome to learn and unwieldy to use, and

Whereas, the metric system furnishes the most simple self-related and convenient units which may be handled in decimals—just as is our monetary system, and

Whereas, practically every country in the world, except the United States and Great Britain, has long since converted to the metric system both internally and internationally, and

Whereas, in the United States many industries (e.g., electrical, American Medical Association, United States Army—about 90%) have already adopted the metric system, and

Whereas, the majority of men in service and many of those in industry are already familiar with the metric system, and

Whereas, at the time of retooling after the war it will be much less expensive for industry which is not already using the metric system to make such conversion, and

Whereas, in international relationships, especially trade, it will be of obvious value to use the same system used by other nations (except Great Britain) for periods ranging from over 20 years to over a century;

Therefore be it resolved, by the National Science Teachers Association, central organization of groups of people interested in science and in education in these United States, that this organization hereby urges Congressional action for post-war national adoption of the metric system of measurements.

Furthermore, the Association is hereby empowered to take any necessary action to promote the purpose of this resolution.

Significantly, the Board of Directors of the National Education Association at its next regular meeting voted to support the foregoing resolution of NSTA. While from such records as remain it would seem that this NEA "support" was chiefly "verbal," the endorsement given by the Board of Directors was an indication of a continuing, if somewhat latent, interest. It was also one recognized form of announcing official Association policy and as such constitutes a significant step.

Association of Teachers of Mathematics in New England, Connecticut, Valley Section. (Adopted at Northampton, Massachusetts, April 1946.)

Whereas, the present systems of measurement in the United States are cumbersome to learn and unwieldy to use, and

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Whereas, the metric system reduces all necessary computations in measurement to the operation of whole numbers, thereby simplifying the learning of arithmetic and the use of arithmetic for computation, and

Whereas, the electrical, radio, jewelry, and optical industries, the American Medical Association, the national and international sports organizations, and the United States Army are now using the metric system in whole or in part, and

Whereas, the metric system has been adopted by 55 of the 57 countries of the world:

Be it resolved, that this Association go on record as favoring legislation by both the Federal Government and the various states for immediate adoption of the metric system throughout the United States, and

Be it further resolved, that this Association is hereby empowered to take necessary action to promote the purpose of this Resolution.

These resolutions are significant for several reasons: (a) they indicate that over the past half century a mounting interest in planned metrication has begun to surface in the educational groups most directly involved with the teaching and application of measurement systems; (b) they represent official group action, as contrasted with individual pronouncements; (c) they are unanimous in declaring that adoption of the metric system would be advantageous educationally—to both teachers and learners; (d) they concur in the belief that official action by the government (not merely education, persuasion, and piecemeal adoption) will be necessary for effective conversion to metric standards; and (e) they show that educators consistently are aware of, and concerned with, the noneducational impact of planned metrication as well as with its educational effects, i.e., with its social, industrial, economic, and diplomatic implications.

Recent Official Action

At the Dallas convention of the National Education Association in 1968 a resolution was adopted which for the first time committed the NEA officially to an *action program* in support of planned metrication—to association support of federal legislation that would bring about conversion to metric measurement. The resolution stated:

The National Education Association recognizes the importance of the metric system of weights and measures in contemporary world commerce and technology.

The Association believes that a carefully planned effort to convert to the metric system is essential to the future of American industrial and technological development and to the evolution of effective world communication. It supports federal legislation which would facilitate such a conversion.

The Association believes it is imperative that those who teach and those who produce instructional materials begin now to prepare for this

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> conversion by urging teachers to emphasize the rise of the metric system in regular classroom activities.[7]

The following year in Philadelphia a similar resolution was enacted. Then in 1970 in San Francisco the Association adopted its current resolution on the subject and made it part of the "continuing resolutions." These resolutions are reintroduced each year automatically, and thus continue so long as they are reapproved by the delegates in later Representative Assemblies. The text of the 1970 Resolution (C-16) reads as follows:

> The National Education Association believes that a carefully planned effort to convert to the metric system is essential to the future of American industrial and technological development and to the evolution of effective world communication. It supports federal legislation that would facilitate such a conversion.
>
> The Association declares that, commencing with the 1971-72 school year, teachers of all grades should teach the metric system as the primary system of weights and measures of the United States.

In the Association's Representative Assembly, where at any given time from 4,000 to 6,000 delegates participate in the business sessions, this resolution and the two similar ones of 1968 and 1969 sessions, respectively, were passed with virtually unanimous support. These repeated expressions of interest, and the specific action called for seem clearly to represent a new dimension in Association commitment.

In 1969 the National Science Teachers Association reaffirmed its traditional support for planned metrication in the following "position statement," prepared by its Committee on Issues and approved by the Association's Board of Directors, July 21, 1969:

> The National Science Teachers Association applauds the authorization by Congress in July 1968 of a study of the advantages and disadvantages of converting to the metric system. We recognize the need for an objective evaluation of all aspects of the conversion process and for sound guidance in planning and implementing those changes essential for a more extensive use of the metric system in the United States
>
> The efficiency and effectiveness of the metric system have long been evident to scientists and educators. The desirability of a worldwide, uniform system of measurement is obvious: approximately 90 percent of the earth's population resides in nations committed to the metric system. For the United States, conversion appears necessary and inevitable. The Association therefore strongly urges that the metric system and its language be incorporated as an integral part of the education of children at all levels of their schooling.

And in the same year the Board of Directors of the National Council of

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[7] National Education Association. *Addresses and Proceedings*, vol. 106, Washington, D.C.: the Association, 1968, p. 531.

Teachers of Mathematics restated that association's interest in a resolution which reads, in part, as follows:

> "*Be it resolved*, that the National Council of Teachers of Mathematics encourage the universal adoption of the metric system of measure.
>
> ". . . While the Board of Directors favors the universal adoption of the metric system, it is also aware of the complexity of this issue and is familiar with the history of many past attempts to effect such adoptions. The Board hopes to contribute in the long run to the adoption of the metric system through the contemplated NCTM supplementary publications on the metric system and through the encouragement of the President to speak out in its favor at appropriate opportunities."

Three state education associations report that they, too, have adopted resolutions which commit them to the support of planned metrication. Copies of these resolutions were not available for inclusion here, but the associations involved are: Illinois Education Association; Missouri State Teachers Association; and Pennsylvania State Education Association.

The Special Interests of Various Educational Groups

Among the NEA staff units and the organizations closely allied to NEA, which collectively are sometimes called the NEA family, many that have taken no official action and done little if anything to promote the idea of change to metric measurement are nonetheless aware of the issues. They are watching and listening with keen interest, knowing that conversion to metric measurement would have both direct and indirect impact on the programs and responsibilities of their members. Some have gone no further than to speculate; others are beginning opinion surveys and other evaluative procedures. Typical of such interest is that expressed by the:

Association for Educational Communications and Technology and by the related staff unit, *NEA Division of Educational Technology*—special interest in the equipment changes that would be made and in the need for new and revised audio-visual materials in the effective teaching of metric measurement.

American Association for Health, Physical Education, and Recreation—special interest in the use of metric units in the construction or modification of athletic areas and athletic equipment, and use of metric measurement in field events, swimming meets, and other athletic contests, including the impact of these changes on American interest, understanding of, and participation in international athletic competition.

American Association of School Administrators—concern about the implications for school management, such as purchasing by the new standards; maintenance during the transition period; construction plans; obsolescence and cost of essential new equipment. Also, the Association is aware of an inherent impact on curriculum development, supervision, and inservice programs.

American Industrial Arts Association—interest centers on how a new system of measurement will affect shop procedures, equipment obsolescence, and pupil achievement in industrial arts classes.

Association of Classroom Teachers—special interest pertains to the impact of planned metrication on both preservice and inservice preparation and on curriculum revision and the modification of classroom procedures. Also, the Association is interested in the extent to which metric measurement would, in fact, simplify the teachers' task.

Association for Supervision and Curriculum Development—special interest in what revisions of curriculum would be needed, including possible economies in time for teachers and students, and in the supervisory leadership which implicitly attends any major program change.

Council of Chief State School Officers—concerned with the total impact of planned metrication on a state school system: its administrative, financial, supervisory, and curriculum implications; its effect on teacher preparation and especially on pupil achievement.

Council for Exceptional Children—concerned with the potential simplification of teaching-learning procedures for slow learning children.

Committee on International Relations (NEA)—interested in the influence of a common system of measurement on the practical problems and effective communication of international travellers, especially teachers and students.

Home Economics Education Association—special interest in the "consumer education" which will be needed in home economics classes as students begin to use metric units in cooking recipes and for garment sizes, fabrics, patterns, and other household measurements.

National Association for Public Continuing and Adult Education and the related staff unit, *NEA Division of Adult Education Service*—special interest in the kind and amount of education that will be needed for effective use of metric measurement by adults familiar only with the current system.

National Association of Elementary School Principals and also the *National Association of Secondary School Principals*—concern with the impact of metric measurement on both the administrative and supervisory problems of a building principal, such as: changes in equipment and materials; teacher preparation; curriculum revision; and pupil achievement.

National Council for the Social Studies—interest in the extent to which our adoption of the metric system would contribute to the development of common worldwide understanding and effective communication. Also, the Association is considering the implications of the introduction of maps scaled to and interpreted in terms of metric units of measurement.

National Council of State Education Associations—special interest in the present attitudes of teachers toward the proposed change and in what would be the optimum timetable for conversion to new standards.

National Higher Education Association—concerned especially with: the potentially better preparation of students to use metric measurement in college classes, in science and mathematics; and with the colleges' new responsibilities in teacher preparation if a new system of measurement is adopted.

A brief poll of state education associations in late August 1970 brought out the fact that three have adopted resolutions favoring change to the metric system: Illinois, Missouri, and Pennsylvania. In addition to the three state associations resolutions already referred to, there is some awakening interest in metrication among these state groups.* Exploratory studies, under state association sponsorship, have been made in both Kansas and Indiana. In the latter state a resolution will be introduced at the association's annual meeting in October 1970. In 41 states where no official action has been taken and no special study made, it is the opinion of the executive secretary in 28 of those states that a majority of the association's members would favor U.S. adoption of metric standards. In contrast, only four executive secretaries are of the opinion that a majority probably would oppose such a change. Nine of the respondents were too uncertain as to teacher attitudes to offer an opinion.

Each state secretary was invited to submit any *personal reaction* he cared to give, either pro or con. Six submitted strong supporting statements; none registered strong personal opposition. Significantly, too, only four of the 44 states responding indicated that they had little interest in the metric conference. Thirty-one were familiar with NEA's official position with respect to metrication; 12 admitted that they did not know what NEA's position was or whether there was an official position. One was misinformed, believing that NEA was officially opposed to any change. This poll reflects no widespread aggressive interest at the state association level, but like other indicators seems to denote growing awareness of, and interest in, U.S. adoption of metric standards.

Metric Measurement in Today's Schools

The one safe generalization about what, when, and how *anything* is taught in American schools is that *no two schools are doing it exactly alike!* However, the following observations with respect to metric measurement in today's schools seem to be generally valid.

First, instruction about the metric system in elementary schools—even the better ones —usually is brief and superficial. Occasionally it may be introduced as early as grade 6, but usually not until grades 7 or 8. The pupil may learn that there are metric units and learn the names of some of them such as meter and kilogram, through his general reading in English, social studies, or science classes. This, however, seldom leads to formal study of the metric system. If taught at all—and sometimes it is omitted—metric measurement is taught in arithmetic and/or science classes. The time and attention given to it varies widely but for the most part is quite limited.

Second, the teaching of metrics for the most part is *about* a system that "could be used" and that "some people use"; not as a system that "we are going to use, and you must learn to use." Even in science classes where metric measurement is used without conversion to imperial units the students learn it as the "language of science" rather than the measurement system for everyday use by all the people. For pupils in today's school metric measurement is merely a *second system*, a parallel system; not the *basic system*. They do not learn to "think metric." In their problems and even in the practice measurements they make with metric-scaled instruments—if any—they typically translate the metric units into the more familiar English units. They think about metric units in about the same way as about cubits, or fathoms, or furlongs. Teachers aware of the common shortcomings compare metric instruction as it is now given with the notoriously ineffective "translation method" in the teaching of foreign languages. What is needed, they say, is a direct approach: the *use* of metric standards until the pupil can apply them and "think metric."[9] It was the inherent difficulty in any such "translation approach" which led Donovan Johnson to say: "The successful teacher of mathematics is like a builder of bridges. He must build a foundation for any new concept for each student by using concrete experiences."[10] And another educator puts it this way: "Education in the use of the metric system will not succeed so long as pupils must be taught to *convert* metric to English and to *think* English. There must be *use* of one system to make the teaching of that one system effective.[11]

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* This poll was carried out with the helpful cooperation of the National Council of State Education Associations.

In spite of this obvious fact a great many elementary schools do not have a single meter stick, metric balance, or any measure of volume calibrated to show cubic centimeters or liters. Without such tools for application and direct experience, any instruction must necessarily deal with abstract ideas and the manipulation of numbers.

Third, research indicates that instruction in metric measurement is gradually improving, as schools move into contemporary mathematics programs. In the so-called New Math program more attention is given to number systems, especially the base-ten system. Newer texts and course outlines, too, seem to include more materials and provide more experience in actual metric measurement than could be found in comparable texts and courses of study a few years ago.[12] An aggressive experiment to improve instruction in metric measurement on a statewide basis is getting underway in Mississippi. The Director of this "Project for Metric Research" is Dr. John M. Flowers, Department of Science, University of Mississippi. Initial response to the program, which involves the mathematics and science programs of all grade levels, has been excellent and significant progress already is claimed for it.[13] Many schools, too, are beginning to discover and use such special materials as F. J. Helgren's *Metric Supplement to Mathematics*, now distributed by the Metric Association, and *Science—A Process Approach*, developed by a joint commission of the American Association for the Advancement of Science with support from the National Science Foundation and marketed by the Xerox Education Division of the Xerox Corporation.

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[9] For a typical presentation of this point of view see: Pray, R. H., *op. cit.*

[10] Johnson, Donovan H., "Instructional Materials in the Mathematics Classroom." *NEA Journal* 56: 40; May 1967.

[11] Johnson, J. T., *Official Report, American Educational Research Association*, Washington, D.C.: AERA, February 1936.

[12] Friebel, Allen C., *A Comparative Study of Achievement and Understanding of Measurement Among Students Enrolled in Traditional and Modern School Mathematics Programs.* Doctor's Dissertation. Berkeley: University of California, 1965, p. 288.

[13] *Metric Association Newsletter*, vol. 5, No. 1, February 1970, p. 3.

Finally, most educators agree, however, that truly effective teaching of metric measurement will come only when the metric system is adopted and incorporated into the fabric of daily living. So long as it is a *second system*, teaching fallacies such as these will persist:

(1) Instruction which should begin no later than grade 3 will be postponed.
(2) Nearly all the teaching will involve association with, and conversion to, the conventional units.
(3) Many elementary schools will spend only a week or so on metric measurement – perhaps in grades 7 or 8 – and never refer to it again.
(4) Metric rulers, etc., will continue to have English units "tagging along."
(5) Text materials and problems will be abstract and superficial.[14]

Because of present day superficial and varying programs, many students arrive in the shops and laboratories of the secondary schools and colleges without knowing how to use metric measurement. They are likely to find themselves quite handicapped if they work alongside others who have been introduced to the metric system. As an example of the neglect all too commonly found an industrial arts teacher writes, "Few, and in many cases none, of the industrial arts students in my classes have facility with the use of decimal equivalents of fractional-inch measurements, much less with their metric equivalents." [15] And a college teacher, complaining of the same weakness in basic instruction, reports that in a test given to 55 college students:

(a) Only 1/3 could give a reasonably good definition of the metric system.
(b) About 1/2 knew the millimeter, centimeter, and meter; 1/3 knew the liter; 1/4 were familiar with the kilogram.
(c) All said they had had very little instruction about the metric system.[16]

Educational Advantages of the Metric System

The educational advantages of the metric system pertain chiefly to two facts: (1) the simplicity and interrelatedness of metric units in contrast to the highly complex and unrelated units of conventional measurement; and (2) the simplicity of computation with whole numbers and decimals in contrast with computation with mixed numbers and fractions.

As to the first point, relative complexity, one advocate of metric measurement says:

> While any intelligent child can learn and carry in his mind the whole metric system in three lessons, and any adult can master the same in

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[14] Helgren, Fred J., "The Metric System in the Elementary Grades." Arithmetic Teacher 14: 349-52; May 1967.

[15] Anderson, W. J., *Journal of Industrial Arts* 25:51; March 1966.

[16] Whitcraft, L. H., 20th Yearbook, NCTM, 1948, *op. cit.*

> one hour or less of serious study, no man ever has, and probably no man ever will, master the United States system of weights and measures.[17]

In support of such criticism it is pointed out that we have different kinds of measures bearing the same name: two kinds of pounds (Troy and avoirdupois); dry and liquid quarts; eight kinds of tons; and 56 kinds of bushels! We have measurement units with limited use such as the cord, board feet, and many others. Standard units interrelated one to another would greatly reduce the number of items to be remembered and used.

As to the computation load, Morgan and others have used a simple problem to illustrate the difference: For a cubical tank 6 ft. 9 1/2 inches on each side find: (1) the volume; (2) the liquid capacity; and (3) the weight of the full tank of water.[18]

In English units the pupil converts the tank dimensions to inches and multiplies; then divides the 541343.375 cubic inches by 1728 to get the volume of the tank in cubic feet. Likewise, he divides the 541343.375 cu.in. by 231 to get the number of gallons. Then to get the weight of the water in a full tank he multiplies the 313.277 cubic feet by 62.5 and divides by 2000 if he wishes to reduce it to tons. These are lengthy multiplications and divisions, involving some 250 numerals and replete with chances for error.

In metric units the task is much simpler. The cubic content is 2.07×2.07 ×2.07, or 8.869743 cubic meters. With 1,000 liters in a cubic meter the liquid capacity is immediately obvious and arrived at by a shift in the decimal point: 8869.743 liters. And since the weight of a liter of water is by definition a kilogram, the tank full of water weighs 8869.743 kilograms. Only 39 numerals are used; one decimal point is moved; there are no lengthy processes; the number of "chances" for error is greatly reduced.

Nearly all teachers foresee *some* simplification of the learning process from the adoption of the metric system, and *some* economy of time that would result from it. *How much* the advantage would be and *how much time would be saved* still remain in the area of speculation and conjecture. One group that is interested in the teaching advantages of metric measurement consists of the teachers of retarded or slow learning pupils, for whom conventional tables of weights and measures and problems that involve the multiplication and division of fractions and mixed numbers are sources of extreme and constant difficulty. C. J. Arnold[19] makes no effort to predict actual saving in teaching-learning time, but says that obviously it takes twice as long to learn two systems as one, plus time to learn how to convert the units of one system into the other. Therefore, he concludes that to give adequate preparation for the use of a dual system we make the teaching task about four times as difficult as it should be.

Some have attempted to be more precise. Ratcliff reports that "educators estimate that the metric system, by eliminating fractions, would save at least a year of time spent by children in learning arithmetic.[20] Both Martin[21] and Johnson[22] have doubled this estimate, predicting that the time an elementary child spends on arithmetic for 2 years would be saved. Johnson says that schools now spend three times as much time on fractions as on decimals, a ratio that could be reversed if the metric system were in general use.

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[17] Wells, William C., *Scientific Monthly* 4:196-202; March 1917.

[18] Morgan, Joy Elmer. Quoted in 12th Yearbook, National Council of Mathematics, 1948. (For complete citation see footnote 3.)

[19] Arnold, C. J., *Minnesota Journal of Education*. 26:288 89; March 1946.

Even more daring is the widely quoted estimate by Floyd W. Hough, chairman of the American Geophysical Study of the Metric System:

> Teachers of mathematics will agree that fully 25 percent of a child's time and the teacher's as well, could be saved in arithmetic courses if the simple interrelated metric decimal units were substituted for the English system of measurement. Such monstrosities as proper and common divisors and mixed numbers could be laid to rest with the celluloid collar and the oxcart.[23]

If the saving actually could be as great as 25 percent, or even the equivalent of the time spent by pupils and teachers for 1 year in arithmetic teaching and learning, that advantage surely would be tremendous. That metric measurement would simplify the learning task, and shorten it *to some extent*, nearly everyone agrees.

One research study which makes no claim of having proved the point, introduces an interesting hypothesis. It is a UNESCO study of the comparative achievement of the school children of 13 countries in arithmetic skills.[24] In this study the children in England and Scotland proved less proficient than those from the countries on the continent with whom they were compared. The authors, in reviewing the result, believe that the most probable explanation lies in the difference in the measurement systems used in instruction, the metric system having been *helpful* in the cultivation of arithmetic skills.

Most important of all from the standpoint of good education is the fact that in the modern world, so dependent on science and technology, the metric system has become the international language of mathematics and science. To be literate in that international language and comfortable in this technological age today's school children in the United States need to become "just as confident and fluent with metric units of measure as their counterparts in the numerous metric nations of the world."[25]

Adjustments To Be Expected

Conversion to the metric system quite obviously will have an impact on numerous aspects of education. There will be many types of necessary readjustment: some of them quite simple; some not so simple. The list which follows is by no means complete but indicates something of the range and variety of changes which must be anticipated in the nations' schools:

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[20] Ratcliff, J. D., *This Week*, April 16, 1944.

[21] Martin, Geo. S., *The International Metric System of Weights and Measures*, Miscellaneous Publication No. 2, Washington, D.C., U.S. Government Printing Office, September 1922.

[22] Johnson, J. T., *Seattle Times*, March 24, 1946.

[23] Quoted by Helgren, Fred J., *op. cit.* p. 349.

[24] Cited by Helgren, Fred J., *Ibid.*

[25] Anderson, J. F. and Arnold, C. J., *"Elementary Education and the 1970's"* Unpublished paper presented at the Annual Meeting of the Metric Association, Boston, December 30, 1969.

(1) Courses of study, especially in mathematics and in elementary and general science, will need to be revised; courses in other fields reviewed for their contributing influence.
(2) Textbooks and related teaching materials must be reviewed and revised or rewritten wherever units of measurement are involved.
(3) Teachers must be prepared—and those already teaching be retrained—to teach the new system effectively.
(4) Supervisory personnel will have to focus on this area as upon any significant change in curriculum.
(5) Classrooms, shops, and laboratories which do not have them already must be supplied with the new measuring devices: meter sticks, metric rulers, scales, etc.
(6) Maps will be introduced with metric grid lines and the distances scaled to metric units.
(7) Graph paper will be scaled by centimeters and millimeters instead of fractions of inches.
(8) Purchasing departments will use new specifications, expressed in metric terms.
(9) Boards of Education will begin to purchase land by the hectare and square meter.
(10) Even the cooks in the cafeterias will soon be readjusting their recipes in terms of metric units.

If the total transition were necessary in one quick step, the expense and disruption of programs would be enormous. If the transition is made in stages, however, over a considerable period of time, neither the costs involved nor the problems of program adjustment should be prohibitive. The experience of other nations bears out that conclusion. Existing facilities, for the most part, continue in use until time for normal replacement. Within reasonable limits the new is introduced as old items become obsolete. During the period of transition the dual system will still persist; the difference being that the metric system now becomes *the basic one*, to be learned and used, and the conventional one a supplementary one for general understanding.

The Experience of Other Nations

Several nations in the recent past have converted to metric measurement—or are now in the process of conversion: Japan, India, Great Britain, Australia, New Zealand, South Africa, and Canada. The impact of metrication on their school programs apparently has not been serious, though in several instances specific information on this phase of conversion is meager. The best reports available on the impact of metrication on the schools are coming now from Great Britain, where the process has been underway for 5 years and will not be completed until about 1975. Out of the experience reported by others come some observations and suggestions such as these:

(1) The system should be introduced into the practices of daily living, and into the schools, in appropriate stages—not all at one time.

(2) Instruction in the schools should at least keep pace with, and when possible precede, the actual application of new measures.

(3) Education must play a major role in the transition. Teachers will work with publishers on new materials. There must be articles in professional literature; short courses, conferences and workshops; experimentation with methods; curriculum study; evaluation of results.

(4) To teach a new system in terms of its relationship to an existing system is the wrong approach. Instruction must be in the *use* of the new system.

(5) A major problem in conversion is logistics. If a manufacturer adopts the metric system and his suppliers do not, he is in trouble. The same will hold in education. Instruction must be geared to teacher preparation and the availability of equipment and materials as well as to the established deadlines for nationwide adoption.

(6) Instruction in metrics should be limited to the requirements of the student for his further schooling, job needs, and daily living. This means thorough instruction in the basic metric units but selective teaching of refined and derived units with limited or special application.

An excellent brief summary of Britain's current situation has recently appeared from which the following excerpt is taken:

> The schools are essential to the changeover. Primary schools were required to adopt the metric system at the beginning of the school year last September [1969]. It had been a *second* numerical language in the other grades for generations. The students now in the primary schools will emerge thinking in metric terms. They should be grateful, because they will have lost a mental rucksack of archaic measuring units. They will have a simple, logical calculating system, which takes far less time than the imperial system to learn and will be the numerical *lingua franca* of the world.
>
> There will inevitably be a period of bilingualism. The difficulty is not in learning the metric system; it is in unlearning the imperial one. It would be unwise to encourage this bilingualism. In Britain we have had a bad example. The weathermen went over to centigrade (which they should be calling Celsius) but radio and television tried to bridge the transition by giving temperatures in both centigrade and Fahrenheit. The result is that everybody waits for the Fahrenheit figure! With this reminder we do not intend to have road signs give the mile equivalents of distances expressed in kilometers.[28]

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[28] Lord Ritchie-Calder. "Conversion to the Metric System." *Scientific American* 223:17-25; July 1970.

The report on Britain's experience outlines the major conversion stages being carried out under the coordinating auspices of a representative Metrication Board. Metric standards will become available and be applied in 1970 to construction industrial materials and to the paper, board, and printing industries. A small start is being made in metric land measurement but the major changeover there will be in 1971. Engineering and shipbuilding are in the first stages of transition and, along with the armed services, have set 1972 as their major target year. Farming also will go metric in 1972 and 1973. Footwear sizes and specifications for fabrics and fibers will be metric in 1972. In 1973 all road speeds will be posted in kilometers per hour. The Metrication Board has no legalistic "big stick." However, it "sets the signals and clears the track" for the switching. Its sanction—which is proving quite adequate—is the warning that any company, industry, or group which is not ready by the agreed upon deadline date will be left behind.

Some Representative Teaching Aids

The statement which NEA is presenting here should not—and cannot—deal with the specific materials and methods of instruction which will make the teaching of metric measurement effective. New teaching aids will be needed, however, as illustrated by the following list of basic items:

(1) Meter sticks and metric rulers.
(2) Cubes, squares, strips, and rods calibrated in metric units.
(3) The meter board, 1 centimeter in thickness and 1 meter by 10 cm, with grid lines dividing it into squares. The same board cut into squares which, when stacked, becomes a cube.
(4) Scales and balances calibrated in grams and kilograms, including the scales used in health departments.
(5) Centimeter grid paper.
(6) Maps in metric scale, showing distances and areas in metric units.
(7) Cylinders and beakers graduated in metric terms.
(8) Celsius thermometers.

Likewise there are a few basic principles in methodology which experience and logic would seem to dictate, such as:

(1) The instruction in metric measurement will need to begin when the child is first introduced to the concept of measuring an object and should continue to be taught, with growing levels of understanding and application, in every succeeding grade.
(2) Linear units of measure, the easiest to comprehend and apply, will be taught first.
(3) Instruction will need to be restricted to a single system, using metric units only and without the old units "tagging along."
(4) Teachers will first emphasize the most-used prefixes, introducing the less-used ones, such as deci- and deca-, after the basic ones are learned.

(5) Relatively greater stress will be laid on the use of decimals and less on fractions.
(6) Much practice will be needed in *using* metric standards and *estimating* in terms of metric units.

Estimated Cost of Conversion

Many variables enter into any estimate of the cost of metrication. When and how rapidly the transition occurs could greatly affect the price tag, so far as schools are concerned. If equipment and materials must be discarded prematurely, conversion could become expensive. If extensive and intensive teacher training must be done quickly, extra costs must be expected. If courses of study and curriculums must be revised under the pressure of close deadlines, funds for such work will be needed. With a more leisurely schedule, the amount varying according to one's assumption, such costs would tend to diminish or disappear altogether.

And again, what is fairly chargeable to the conversion program? How much of the curriculum revision and in-service education, for example, would go forward in any event – if not on metrication on some current educational problem? What part of the new equipment cost for metric materials would be spent on new equipment of some type no matter what system of weights and measures is in effect? What administrative costs associated with metrication are separable and identifiable and which ones would persist if conventional measurement were still in effect? And so it is with other assumptions. There are many obvious variables and very few objective data on which valid estimates can be based.

As stated already, the time schedule for conversion is a critical factor in determining probable school costs. Textbooks and semi-durable instructional materials for elementary and secondary schools are replaced on an average, 5-year cycle. Hence no appreciable *extra* expenditure for texts and semi-durable materials will be involved if the conversion schedule exceeds 5 years. For more durable equipment some additional obsolescence might be involved, though this should not be excessive. The longer the conversion period the more new metric-scaled equipment can be acquired on normal replacement schedule. The NEA Research Division estimates that to purchase essential new materials and equipment in a single year, at present cost levels, could run from 500 million to 750 million dollars. But if absorbed over a span of several years any *extra costs* should be minimal.

In the same way the cost of teacher preparation, both preservice and inservice, and any additional administrative and supervisory costs can be largely or wholly absorbed into ongoing programs if the conversion schedule extends over several years. In short, educators foresee no major cost problem for schools, if the United States decides to adopt the metric system – so long as the conversion period is long enough to make use of normal cycles and schedules.

One further fact about probable school costs should be kept in mind. Just as there *should be* no excessive additional costs associated with the conversion, there *will be* no "dollar savings" to the schools—as some have implied. Any saving in "learning time" for pupils and teachers that the metric system may produce will simply release that time for other learning experiences—it will *not* reduce school costs.

The Metrication Schedule

The National Education Association does not presume to offer a specific schedule for conversion to metric standards. The educational impact will be only one of many considerations in the development of target dates and conversion deadlines. And even if the educational impact were all-controlling, who can say just what schedule of conversion would be best for the nation's schools. On some facets of this problem, however, there is wide general agreement among educators:

(1) When and if the decision is made to go metric, a "reasonable lead time" would be helpful before any significant segment of the economy makes the critical move.

(2) A dramatic kick-off date, with concerted publicity and fanfare, would help to motivate the early school efforts.

(3) An officially-established, representative board—somewhat like Britain's Metrication Board—would seem to be a helpful agency in setting up and following an orderly, coordinated schedule. Separate deadlines will be needed for various areas of conversion such as, the time for metric measurement to become effective in the sale of groceries; a deadline for metric standards in large industries such as petroleum, coal, steel, automotive, or aircraft; a deadline for fibers and fabrics, papers, and other consumer products; a deadline for metric units on road signs; the time to begin land sales by metric measurement; etc.

(4) If such a schedule is followed, over a spread of perhaps 10 years, schools will have few serious problems of adjustment as they keep pace with conversion efforts.

(5) Undue delay in starting the program—too much lead time in preparation—would be self-defeating, a retarding influence on the work in metric measurement now being launched and extended in the better schools.

Conclusions

First, by and large, the nation's teachers who have seriously considered the matter seem to concur with science and mathematics specialists that adoption of the metric system by the United States will be advantageous not only in the realms of science, technology, and international trade but also in the area of education. They are aware that problems of adjustment will arise and some added costs may have to be assumed. But there will be teaching advantages and educational economies as well.

Second, the educational impact will be most direct and extensive, but also easiest to accomplish in mathematics and science instruction; but any changeover to metric measurement will be felt in nearly all segments of the school program—for the most part a type of impact that will be welcomed as an improvement.

Third, many schools on their own initiative are beginning to extend and improve their instruction with respect to metric measurement. However, their work lacks motivation and will not become really effective so long as the metric system is a secondary and parallel system. For that reason the official adoption of the metric system by the United States would assist all such schools.

Fourth, the educational advantages of metric measurement cannot be questioned: the simplicity of the system: its interrelatedness: its use of decimals instead of fractions. Few would challenge the fact that the teaching-learning task would be eased for both teachers and pupils, especially for pupils with learning problems.

Fifth, some considerable economy would be effected in the time traditionally spent on elementary arithmetic by both teachers and pupils—time that could be better spent on other types of learning.

Sixth, while obvious problems and some added costs must be anticipated it is our considered opinion that the extent of the problems and costs has frequently been exaggerated; that many of them will be resolved and absorbed almost unnoticed once a well-planned schedule of adoption gets underway.

Finally, we believe that with a reasonable margin of lead time and a program of gradual adoption, spread over a period of perhaps 10 years, there will be few serious problems for schools and educators and none with which they are unable to cope successfully.

For these reasons the position taken by the National Education Association in 1970 and in other recent years seems eminently justified, namely, that a carefully planned effort to convert to the metric system in the United States should be put into effect as soon as possible. When this occurs educators can be relied upon to do their part, willingly and efficiently, in making the new system understandable and functional as the international numerical language of a progressive nation.

STATEMENT OF NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

The National Society of Professional Engineers, a nonprofit organization headquartered in Washington, D.C., and consisting of nearly 70,000 members who are engaged in virtually every aspect of engineering practice, appreciates the opportunity to apprise the Congress of our support for passage of S. 2483.

This bill provides that the international system of metric measurement shall become the official U.S. system of measurement within ten years following the bill's enactment. It would direct the Secretary of Commerce to develop and implement a coordinated national plan of metric conversion in consultation with agencies of the federal, state and local governments as well as with foreign governments and international organizations. The Secretary would also be directed to provide for the participation of industry, science, engineering and labor representatives. The measure would, furthermore, authorize a program of metric conversion assistance through accelerated tax writeoffs, grants for purchases of new tools, conversion loans, public education programs, and other vehicles intended to enable the nation to move toward adoption of the metric system with a minimum of dislocation and a maximum of economic benefit.

Most professional engineers support this approach. The arguments favoring metrication in the U.S. are manifold and persuasive. Many of the country's industries, in fact already use metric dimensions. Although wholesale conversion will probably be inconvenient to many of the others, and undoubtedly costly to all, engineers feel that the alternative of not converting will, in the long run, be far more expensive in terms of the diminished U.S. position in the international market.

There is also a strong conviction in the engineering community that use of the metric system will make it easier for engineers to communicate with the scientific community, and with all counterparts internationally, thus facilitating a greater exchange of ideas and a simplification in commerce. Some engineers point out that their individual opportunity for mobility to and from the scientific and educational fields would be improved. Others look upon metrication as a well-timed occasion to promote better engineering and consequent improved products through modernization of existing codes and standards. And still others anticipate that use of metric will ease engineering's computational workload and reduce the potential for error.

Conversion, once decided upon, should be effected in as short a period of time as feasible so as to reduce the transitional process to a minimum. While some engineers speculate that the ten-year period provided for in S. 2483 is a fairly lengthy time, they recognize, at the same time, that the period for capital equipment replacement must not be made unreasonably brief. It is suggested, therefore, that the transition period provision of the proposed law be as well thought out as possible before adoption.

Another point on which professional engineers have a firm conviction is the need for a pervasive and immediate educational program at all levels in America's schools. The metric educational process, engineers feel,, should begin at once with every American student from kindergarten all the way up through graduate school.

The subject of metric conversion over the years has been the subject of discussion among the membership of the National Society of Professional Engineers, and, acting on a recommendation of the Society's Professional Engineers in Industry Practice Section, the Society's Board of Directors adopted the following formal resolution on July 8, 1971:

"The National Society of Professional Engineers respectfully urges the Congress to enact legislation leading to adoption of metric units as the standard of measurements of the United States within a period not to exceed ten years. The transition should be accomplished in planned stages so that everyone in commerce, industry, construction and everyday life may become thoroughly familiar with the metric system and minimize confusion. Instruction in metric units should begin at once in all educational institutions to students of all ages. Each state and all governmental agencies should be advised to adopt legislation and procedures necessary to conform to the national policy.

The Society is convinced that the benefits to all future generations of conversion to the metric system of measurements far outweigh the difficulties that will be encountered in the transition period."

The National Society of Professional Engineers favors S. 2483, and urges its enactment into law.

STATEMENT OF FREDERICK L. WILLIFORD, EXECUTIVE VICE PRESIDENT, NATIONAL MICROFILM ASSOCIATION

Mr. Chairman: The National Microfilm Association supports the systematic and planned transition from the current U.S. Customary System of Weights and Measures to the International Metric System.

The National Microfilm Association is a national professional/trade association representing over 5500 users and manufacturers or vendors of microfilm equipment and systems.

Virtually every segment of our economy, including government, is represented within the user group in our membership. Almost every major manufacturer, vendor and supplier of microfilm equipment is also represented in our membership. The National Microfilm Association is the recognized representative association of the Micrographics Industry.

Indicative of our association and industry commitment to the metric system, the Association officially endorsed the recommendation to the Congress made by the Secretary of Commerce, the Honorable Maurice H. Stans, that the United States change to the international metric system as deliberately as possible.

Our Association recognizes that the orderly transition to the metric system requires considerable education. Our Association has responded to the educational needs of our industry. A chronology of our efforts and the success we have enjoy will be of interest to you and to the Committee.

Following the Association's official endorsement of our industry's conversion to the metric system (Feb. 10, 1971), we immediately embarked on an educational program to provide accurate information on conversion factors, symbols and information on conversion factors, symbols and information which would facilitate conversion and prepared an illustrative brochure indicating metric units, symbols and abbreviations. This informational bulletin was sent to our entire membership to assist them during the transition period.

We also developed a "Metrication Computer" which is an ingenious slide rule especially designed for the micrographics industry. The Metrification Computer permits easy conversion of liquid volume, luminants, flow, length and mass from U.S. units to metric units.

At the present time we are disseminating to all interested parties within the industry a series of metrication posters with the theme "Think Meric" which shows visually the comparisons between the U.S. measure and the metric measure.

Coupled with user education, the Association has embarked upon an effective program to encourage the manufacturers and vendors of systems and equipment to adopt the metric system in their manufacturing and systems design. As of this date, 17 companies, representing a substantial portion of the industry sales volume, have officially adopted the metric system in their microfilm divisions as a direct result of NMA efforts. There companies are as follows:

Allied Microfilm Corp.; Bell & Howell Co.; Dakota Microfilm Service, Inc.; E. I. duPont de Nemours & Co., Inc.; Eastman Kodak Co.; The Ednalite Corp.; GAF Corp.; Itek Business Products Div., Itek Corp.; Kalvar Corp.; Kleer-Vu Industries Inc.; 3M Co.; Microfilming Corp. of America; Prestoseal Manufacturing Corp.; Realist, Inc.; U.S. Microfilm Sales Corp.; Washington Scientific Industries, Inc.; and Wilson Jones Co.

In addition, our technical journal and our news letter continually encourage our industry to prepare themselves for the official adoption of the metric system by the U.S. government.

Although we have not had an opportunity to study the proposed legislation, we respectfully urge the Committee to be favorably disposed toward the systematic and early adoption of the metric system in the United States.

STATEMENT OF ANDRE NADASH

Mr. Chairman and members of the committee, I am Andre Nadash, an independent consultant specializing in metrication, and I am pleased to present my statement, and ask that it be inserted into the record.

I came from Budapest, Hungary, where I had a small instrument factory. We also manufactured diverse parts and as everyone else in the industry, if needed, were able to do these in non-metric measurements also.

I was educated in Europe, presented papers and lectured, particularly on measurements. I was a member of the Measurement Technique and Automatic Scientific Association, a subsidiary to the Hungarian Scientific Academy. I also had the pleasure of attending practically all of the Bureau of Standards US Metric Study Conferences. I am presently Director for the Mid-Atlantic Region of the Metric Association.

As my education was in metric, I feel that I might contribute some worthy thoughts in the debate on metrication, which we have fought since 200 years. Even though some of my thoughts at first do not seem to be related to the subject, in the final analysis it will have a big impulse in the right direction.

It was in 1790 when Thomas Jefferson asked Congress to change to a new measuring system, which was reported by the French National Assembly. However, it was only some years later that the system was completely established.

On May 18, 1866 the 39th Congress, 1st Session, authorized the use of the metric system of weights and measures under ACT #H.R. 596 and H.R. 597.

In 1875 the Treaty of the Meter was signed by 17 Signatory Members: Argentina, Austria-Hungary, Belgium, Brazil, Denmark, France, Germany, Italy, Peru, Portugal, Russia, Spain, Sweden-Norway, Switzerland, Turkey, United States and Venezuela. All of them—except U.S.—has been on metric for a long time; and we, who signed the Treaty, are the only industrial nation in the world still using a long outdated system—even though with this signature and some other administrative procedures we are officially a metric nation. Therefore, I raise the question—why are we discussing metrication in its present form instead of simply saying, learn and think metric because the non-official and outdated present units of measurement can't be used—say after 1980.

Here I would like to mention that the need to measure anything with the same measurement all over the world is not new and is not a necessity developed in our "modern age". It dates back long before 1700 and there is strong evidence that some 5,000 years ago, during the Indus Valley Civilization (3,000-1,500 BC) in North-West India, an unbelievable uniform system of weights and measures existed. Now 5,000 years later only some small and non-industrial countries are non metric and even those are in preparation to adopt the metric system.

May I give a little more statistics regarding countries which are recently going metric, with the remarks that those in all capital letters made the decision in 1970, the others earlier:

Australia
Bahrain
BOTSWANA
Canada
CEYLON
FIJI
Ghana
GIBRALTAR
Ireland
Kenya*
Kuwait
MALAYSIA
MAURITIUS
New Zealand
NIGERIA
Pakistan
SINGAPORE
South Africa
Swaziland
Tanzania*
Uganda*
United Kingdom
ZAMBIA
BERMUDA**

At present, the non-metric countries are: the Caribbean countries, or if you prefer West Indies and South American Guyana, but they are in a planning stage. Puerto Rico is familiar wth both systems and road signs are in kilometers and miles. What is left at present is in Southwest Asia: Muscat & Oman, Southern Yemen and Burma; in Africa, Gambia, Liberia and Sierra Leone; the small islands in the Pacific, Tonga and Nauru (British Commonwealth).

Shortly the whole world will become metric and there is no doubt, that we as the most technologically advanced nation—the only nation in the world whose astronauts planted its flag on the moon, that we will remain on earth with the outdated inch and pound system and watch our trade deficit growing. We have to compete in every way with the other nations and to do this we must definitely go metric and have the same language of measurement that every other advanced nation uses.

May I submit some statistical data which proves our guilt in the past on postponing metrication and which will show how much more difficult it will be in the future if we postpone the changeover now. I will deal basically with three statistics only: population, roads and cars.

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*Will finish changeover this year.
**Has decided in 1971.

1. *Population* (rounded figures): 1790, 4,000,000; 1860, 31,500,000; 1870, 40,000,000; 1880, 50,000,000; 1890, 63,000,000; 1900, 76,000,000; 1910, 92,000,000; 1920, 106,000,000; 1930, 123,000,000; 1940, 132,000,000; 1950, 157,000,000; 1960, 180,000,000; 1970, 205,000,000; 1975, 220,000,000 (estimated); 1980, 240,000,000 (estimated); 1985, 260,000,000 (estimated).

Population grew tenfold from 1790 to 1870, and approximately doubled in the next 32 years. Then in less than 50 years it doubled again; or from starting point of 1790 until 1970 the growth was over 50-fold. I do not have statistical figures at my fingertips regarding school enrollment but even so it is easy to see or estimate the growing need for education. If we had metric educated everybody in 1790, it was only 4,000,000 people to educate. At that time it was much easier as we had practically no industry, cars, roads, etc. In our complex world of today we have to educate more than 50 times more people; and without any statistical basis I assume that only the school-age population now is more than 20–25 times the entire population in Jefferson's time. I have, however, data from Valley View, an elementary district about 50 km south of Chicago. In 1953 Valley View had five one-room country schools with a total enrollment of 89. Ten years later, in 1963, enrollment was 2,400; in 1970 it was 7,000.

2. *Roads:*

It is not my intention to give complete statistics on roads, however, I would like to mention that at the beginning of this century we had about 80,000 miles of primary roads and in 1965 414,000 miles—adding together the secondary and other roads, it totals 3,690,000 miles. If my information is up to date, then the total road mileage at the end of 1970 was 3,710,300. I can easily assume that most of the present road mileage (even second and third-class roads) are better roads than the 80,000 at the beginning of 1900.

3. *Cars and other motor vehicles:*

The number of registered cars in 1900 was 8,000; 1903, 32,920.

With trucks included, this came in 1904 to 55,290; 1905, 78,800; 1915, 2,490,932.

With trucks and buses included in 1925 to 20,068,543; 1935, 26,546,126; 1945, 31,035,420; 1955, 62,688,792; 1965, 90,357,667; 1969, 105,096,603.

The roads, of course, have not grown in length to the proportion of the number of cars, but many of them have been made much wider, better and, naturally, new roads were built to take care of the rising number of motor vehicles. Changing of road signs is a fairly costly procedure for the Federal and State Government but with proper coordination with the Maintenance Department, this cost can be minimized and the changeover managed without any trouble. If we build new roads now, it has to be dominantly done with metric signs.

I recommend practically the same procedure with cars. I'm not talking in the field of metric engineering, in which the public is not interested, only in the metric instrumentation; namely, the speedometer and odometer in km. The gas tank gauge is marked anyway in full, ¾, ½, ¼ or empty. A low-cost drive ratio-corrector or drive ratio-adapter can easily be engineered for old cars on the road. This was made for American cars in Europe in the past.

I strongly recommend that in every field of metrication the cost lie where it falls. Large industry can in 10 years absorb the cost of metric tools and dies as the old tools have to be replaced from time to time, because they are either outdated or worn out. The same is true of smaller industries; and as the entire industry modernizes with new machinery, they have in addition a good tax advantage. It is not my intention to go into a lot of details now regarding many industries and mainly the changeover expense by the labor force, but I would like to state some possibilities in order to present the right perspective as compared to the exaggerated figures.

It is mainly the machine-shop worker who needs the so-called expensive tools and some of them need more than others. If there is a subsidy, they would request more than necessary—thus getting free tools in the name of metrication. Here I suggest that a company buy the tools, as they can get them at a much better price than the individual workman. Let the company give the workman metric tools in exchange for his old tools. The old tools are to be kept by the company for ten years and then returned to the workman. If the workman leaves the company, he turns in his metric tools on loan and gets back his deposited old tools. Or, the worker can pay the cost of the tools within a 10–12 month period and get back his deposited tools. The amount paid for the metric tools is tax deductible.

The temporary inconvenience is nothing compared to the benefits of metrication at the end of the metric transition period. It will show benefits in education, standardization, cost, international trade—simplicity in every way we measure. Many machines and tools can produce metric parts with a little adjustment or minor modification.

May I repeat myself—I'm against any subsidy! Metricate and not subsidize. If we start with a a subsidy, then every car owner can ask for a subsidy to change his speedometer to metric and every housewife is also entitled to a subsidy to change bathroom and kitchen scales to metric.

The entire change to metric is much simpler than some see it and the estimate of a $100–200 billion cost is grossly over-exaggerated. We have learned from Great Britain that the cost of metric conversion is much less than expected. When someone says that everything has to be changed, then I recollect a statement from the Singapore Metric Board "Nobody would be so foolish as to claim that he cannot make metric furniture because he does not possess a metric saw to cut the wood with."

I was sorry to note that some Union spokesman talked about members of the Union, the working man and the consumer, as not being able to metricate—underestimating their knowledge which is far from the truth. I'm not a Union member but resent the idea, if not directly but indirectly, that these people are considered unintelligent. I have reliable information that in Great Britain, which is about halfway in the process of going metric, a plumber who comes out to the house for repair work talks only in metric terms. I do not believe that the American workman and consumer cannot do the same and under-estimating their knowledge is only to undermine the whole metrication program. But, if it is true that the American workman and the public in general is so under-educated, it is more proof that we need the metric system now, which is much easier to learn than our present outdated and very complex system. It is, too, common knowledge that these workmen earn high wages. Why should his wages be so high if he is not even capable of learning to convert to a simple method.

Many of our workmen, by the way, have learned something about the metric system in schools; however, we don't have a firm metric educational program as of today. It is also learned in the Service, where a lot of metric is already used (and also NASA). Traveling to Europe has made millions of people aware and familiar with the metric system, and I have not found one who does not prefer it to the inch-pound system. We can save a lot of time in education by teaching metric—which time can be utilized elsewhere where it is most needed.

Some of the metric opponents I suppose don't even know what they are talking against. Many things in our every-day life are already metric without people realizing it; i.e. TV, Electronic, Electricity, Photo-film, Microfilm, Medicine, Science, etc. If talk is about confusion in the changeover period, they never realize how little actual measuring is done by the average person. Gas, for example, is bought either by "fill 'er up" or by the Dollar ($2 please); or we buy beer by the bottle or six-pack and will buy it the same way, even if it will be measured in different units and will be just a little bit different in size. In no time, these different numbers or sizes will become familiar and a precise definition will not be important in every-day life. This method will not present problems to the average man or housewife and they will rapidly become used to buying goods in metric quantities, with only an occasional mental conversion at the beginning. As soon as we are metric—let us say in food and related items—there is no more need to prepare "unit prices" because the consumer himself can figure it out easily. There is no possibility "that the confused consumer would be easily cheated", as one labor spokesman said. It is just the opposite, and though I have respect for the knowledge of the public, I must admit that with our present system they can be cheated; as it is not easy to compare prices on merchandise packed in fractions, ounces, double pack, king size, etc.

It is more important to think metric than to convert back and forth. We soon learn that the freezing temperature is 0 °C; comfortable room temperature is 22 °C; and the body temperature is 37 °C, with 38 being feverish, 39 very feverish and 40 to 42 is dangerous; and boiling temperature is 100 °C and thus the average individual has learned enough to avoid conversion. The simpliest and accurate enough conversion is:

$$(F - 28) + 2 = {}^\circ C$$

$$(\text{Fahrenheit})\ 50 - 28 = 22 + 2 = 11\ {}^\circ C$$

However, without converting one to the other, the meteorologist on TV can be the best teacher.

In New Zealand the meteorological temperatures are already expressed in Celsius (°C) and rainfall in millimeters (mm) since July 1971. The change was made following two weeks of intensive publicity. After the change, Fahrenheit degrees and inches of rain were completely dropped from all meteorological announcements. I'm sure we can do the same. Just start educating the people without over-educating them. A meter is a meter and we don't have to explain wherefrom we derived the meter, but some years from now, after the meter becomes a household word, we can come up and say that the Equator is 40,000 km, etc. This is more than enough for the average person. There is no reason for over-educating the average man with scientific theory, as most of them don't know or ever heard about krypton, wavelengths in vacuum, spectrum, interferometer, etc. and, therefore, are unable to understand it. Educate but make it simple and understanding without over-educating.

May I mention also that almost every industry is using in some way or another metric measurements and without coordinated government help our changeover will be an uneconomical 40-year struggle, as it was in Japan.

A well-coordinated 10-year program is what we need and, of course, every sector of the industry has to work out its own program to do its best and with lowest cost. This paper is not intended to go into more detail for every sector for it is not needed, as the Bureau of Standards' Metric Study covered everything so well.

If I would want to criticize the report to Congress "A METRIC AMERICA, A decision whose time has come", I can only criticize the title, which might have read "A Metric America, a Decision which is Past Due for 100 Years."

With metrication we help to break down the trade barrier, as many foreign nations refuse to buy non-metric products; for example, we could sell our cars where we can't today. Ford Pinto (GM-Vega is partly) is metric car and Ford has built a new $100,000,000 plant for the Pinto, yet other Ford cars are non-metric. We would like to hear from Ford here what Allen Aitken, Great Britain Ford's Director of Car Engineering, says; namely, "Every measurement from the clay model stage of a new car to the final prototype is now fully metricated." Not only cars and other finished products made in non-metric have a handicap in exporting to metric countries but also any liquid product in non-metric bottles, food, canned goods, etc.; even shipping papers can and have caused difficulties and confusion.

We must realize that no 100% metric nation exists at the present. Metric countries which obtained, for example, locomotives from U.S. and need any replacement parts will have to be supplied with the same as the original. If a pressure gauge with a half-inch thread connection is needed, it will have to be replaced with a half-inch thread. As long as any machinery, instruments, etc. are usable but should have to be repaired, they have to produce the parts needed in non-metric sizes; but it will eventually die out and then all will be metric.

There is no question that we have to do our utmost to expand our international trade and to eliminate our present trade deficit. There is hardly any sector in our giant industry which will not profit from the growing export market. Contrary to some predictions that we would lose business if we converted, I have evidence that even though we are non-metric now, some of our smaller industries have already produced and delivered abroad cutting tools, drills, taps and dies, etc. in metric sizes.

The dry-wall board and plywood industry exported boards in metric sizes and it was no hardship for the worker to change over and back again. It is impossible to reach every sector of our industry in a short statement, detailing what they have done, what they should do, how to convert, etc.; but I must say that we have had enough talks and discussions in the past 200 years, and now is the time to do something in a positive way.

Our unemployment rate would benefit by a changeover. We need technically more educated people, for instance, to change fabric measuring devices, gasoline pumps, face plates on scales, postal scales, computing scales, etc. to metric; mass production of new kitchen and bathroom scales, weights, new thermometers for industry and home use, liquid measuring devices; control devices for mass, liquid temperature, etc. There would be no industry which would not be affected.

In short:

1. A nationally coordinated plan is essential and with proper leadership we can change to the metric system (S I) even better than others have done, since we can learn from their experience (G. B., South Africa, Australia, New Zealand, Canada, India, etc.)
2. A well coordinated ten-year changeover period is necessary as many sectors of our industry already have gone metric on a voluntary basis.
3. A strong metric education program has to be launched, starting with the first grade and perhaps even kindergarten.

4. It is foremost important that all cost be held to a minimum and lie where they fall.

I am grateful for the opportunity to present my views and I am ready and willing to help and assist in changing this 200-year debate to a 10-year changeover period, after which we can proudly announce—USA is metric!

Statement of Dr. John M. Flowers, Vice President, Metric Association, Inc.; Director, Project for Metric Research, College of Science, Department of Science Education, University of Southern Mississippi

Mr. Chairman, it is a privilege to have the opportunity to summarize more than a decade of experience in teaching the metric system to hundreds of college chemistry and physics students, to thousands of non-science majors in undergraduate science classes, and to many students in elementary and junior and senior high school. This experience also includes participation with teachers in formal and informal metric study workshops.

Learning to think in metric terms is not easy, but in a carefully organized and coordinated program it can be done in a reasonable time and without excessive cost. A very large segment of our population in schools, business, industry, and society as a whole is ready and willing to learn to use metric units as the predominant measurement language.

A search of the extensive recent literature on the subject in newspapers, popular magazines, and scientific and technical journals reveals that, in situations where unequivocal measurement is of primary importance, conversion of the United States to the metric system is an accomplished fact. Every major scientific and educational organization has endorsed the thesis that thinking and working in metric terms is an immediate need, and has called for nationwide measurement education programs.

It should be made clear that the International Metric System referred to is *le Système International d'Unités* and is known as SI in all languages.

Regardless of the program for metric conversion which is eventually adopted, there are two immediate actions which should be taken by the Congress:

1. Declare the international metric system as the official and standard system of measurement for the United States.

2. Authorize the Commissioner of Education to participate with public and private nonprofit institutions to develop and carry out programs for educating every American schoolchild and the public at large to think in metric terms.

Additional actions can be taken later after due consideration for the needs and desires of all sectors of our society.

Statement by Washington Society of Engineers on the Metric System

When the United States and the United Kingdom were the leading industrial nations of the world, their exports of capital and manufactured goods were in such demand that they could be exported with little consideration of the systems of weights and measures in use in the importing countries. Now there are many highly industrialized nations all competing in the world market. The US and the UK are faced with stiff competition especially in the field of metal working machinery and machinery and allied products. Our total exports are declining and we have an adverse balance of trade.

The UK has officially embarked on a ten-year conversion program aimed at improving her competitive position in the world market. Ninety percent of the world is on the metric system leaving the US and Canada (with 10% of the world population) the largest countries remaining on the inch-pound system.

By Congressional action the Department of Commerce is now engaged in a study to determine the impact of increasing worldwide use of the metric system on the US. The report to the Congress will be the basis for possible legislation. Ease of calculation in trade and industry and ability to compete in overseas commercial, industrial, engineering and scientific activities have been cited as justification for the changeover.

The Washington Society of Engineers believes that:

(*a*) An educational program is desirable to acquaint the public with the metric system.

(*b*) Engineering and technical societies should assist the Government in its current study.

(*c*) All engineering based industry (such as construction, capital goods, machinery and allied products) should assist the Government in its current study.

(*d*) All persons whose future activities will be significantly affected by a decision to "go metric" are urged to consider carefully its impact on the economic health of the country.

(*e*) Legislation will be required to fully implement the use of the metric system. A period of dual usage will be necessary with the new units of measure.

[From the Washington Post, Oct. 3, 1971]

METRIC SWITCH GAINS FAVOR, BUT STILL UNKNOWN TO MOST

(By George Gallup)

PRINCETON, N.J.—Secretary of Commerce Maurice E. Stans expects the United States to convert to the metric system in about a decade's time, assuming there is approval from Congress. All major nations of the world but the U.S. use the metric system of weights and measures.

The latest nationwide Gallup survey shows the public is far from prepared for a changeover. Conversion would affect every citizen—from the housewife to the bank president. U.S. schools would have to make major adjustments, although many high schools are already teaching the metric system.

The latest survey shows that fewer than half of U.S. adults (44 per cent) say they know what the metric system is. Among those who are aware of the system, however, opinion is divided evenly between those who favor and those who oppose adoption by the U.S., 42 to 42 per cent. Another 16 per cent express no opinion.

In the current survey eight in ten persons who have attended college are aware of the metric system and opinion in this group is 5-to-4 in favor of adoption of this system.

While the public appears to be less than enthusiastic about the metric system at the present time, a comparison of the latest survey with a comparable one in 1965 shows a growth both in public awareness and support for adoption of the system.

In the 1965 survey, 29 per cent indicated awareness of the metric system, compared to 44 per cent today. In addition, the weight of opinion at that time was against our adopting the system, 46 to 37 per cent, whereas now opinion is evenly divided.

The latest survey results are based on personal interviews with 1505 citizens, 18 and older, living in more than 300 scientifically selected locations in the United States during the period Aug. 20–23. This quesiton was asked first:

Do you know what the metric system is?

Following are the latest results compared with those from the 1965 survey—nationally and by education level:

Following is the national comparison between 1965 and 1971 in levels of awareness:

	Percent
1965	29
1971	44

In both surveys the aware groups were asked the following question:

Would you like to see the U.S. adopt the metric system?

Following are the latest national results compared with those from the earlier survey:

(Based on aware group)

	1965 Percent	*1971 Percent*
Yes, favor	37	42
No, oppose	46	42
No opinion	17	16
	100	100

[From Product Engineering, Mar. 1, 1971]

BRITISH FI[illegible] A BOTHER AND A BOON

Despite many frustrations, British engineers are more solidly in favor of "metricating" (their word for switching to metric or SI) than when they started their voluntary 10-year switchover in 1965.

The reason for British enthusiasm is simple: Opportunities to discard outmoded ways of doing things, and thus eliminate marginal product lines, have been particularly rewarding. And, most important, designing in SI-only for trade with metric countries, English engineers have seen overseas business increase between 40% and 60% in 15 years.

The problem. However, even today when these engineers are past the halfway point in their conversion period, they are still finding that metricating is often like the old army game of "hurry up and wait." You race to complete your own designs for a product in SI, only to wait on converted drawings or metric components from other sections or suppliers.

When Alan Longworth, designer of home appliances for Ascot Gas Water Heater Co. Ltd., part of the Radiation group of companies, receives drawings from other divisions that have not yet gone entirely metric, he must devote about 5% of his time to complicated conversions.

Longworth's company was one of three that *Product Engineering* visited in 1968 for an article published at the time the U.S. Metric Study was getting underway (PE—June 3 '68. p. 18). Another of the companies visited was English Electric Co., which is now 85% metric. Edward Pearson, its chief engineer, is as enthusiastic about metrication as he was in 1968.

English Electric, like most British companies, is coupling the metric change with plans for launching new product lines, probably timed to coincide with Britain's entry into the Common Market. Pearson says the U.S. must "get on" with conversion because of all the overseas trade opportunities it will miss if it doesn't.

A major holdup is still one of getting supplies.

AND ELSEWHERE

Obtaining supplies in metric dimensions was a problem for Stavely Machine Tools Ltd. when it began metricating in 1968. At first, for example, cap screws in metric sizes were hard to find—and cost 10% more. Stavely had the choice of reverting to standard British sizes (entailing redesigning, plus rewriting maintenance and instruction mannuals) or making the screws itself. It chose the latter course. For another product line, Stavely had to go to the Continent for some metric components.

But the metricating story at Stavely is not all dark. New lines of metric milling machines are selling well, and there is also a new instrument that can be attached to the lead screws on certain machine tools to provide simultaneous read-outs in both SI and inches. Developed to meet the company's own machine shop needs, the $48 instrument is selling at the rate of 1000 a year.

Although Stavely has already made substantial sales to metric countries (including several million dollars' worth of gearboxes to the USSR and eastern Europe) that would have been impossible before conversion, B. J. Davies, sales and marketing manager, is aware that Continental suppliers will find new markets in Britain as well. But he thinks the competition will be beneficial.

COST UNKNOWN●

But the English cannot tell even today what the costs of such benefits will be. Gordon Bowen, director of the British Metrication Board, told one of the U.S. Metric Study conferences last fall: "Many of our firms with sophisticated accounting techniques have concluded that trying to identify the metric cost element is not truly meaningful and certainly not worth the accounting effort required."

In retrospect, however, the British wish they had done some things differently. For example, it was a mistake not to push for official government backing. Also, the Metrication Board itself was not set up until 1969, four years after the program got under way.

But perhaps one of the most significant practices that has developed in England to push conversion along is that many companies and even trade associations have engaged in activities normally forbidden by British antitrust statutes. These have been "winked at." More than one U.S. observer has suggested it would be well to investigate the antitrust implications of a U.S. conversion program with the Justice Dept.'s Anti-Trust Div.

[From Product Engineering, Mar. 1, 1971]

WORLD STANDARDS SPEAKS SI ONLY

There are some impressive engineering authorities in the U.S. who will tell you that the question of conversion to the metric or International Standards (SI) is incidental to the more basic question of this country's perilously weak position in the writing of international standards.

This position is so bad that it contrasts sharply even with the less-than-perfect domestic U.S. standard-making apparatus. Worse yet, too many U.S. engineers and businessmen view with suspicion the very active efforts of industrial nations abroad to codify and make more uniform the frequently conflicting national standards that make Europe a standards chaos even today (PE—July20'70,p40).

ROLE OF THE U.S.

Such efforts are really attempts to achieve the same uniformity that U.S. industry has long enjoyed in many fields.

Witnesses to the critical situation are numerous and vocal. For example, J. S. Weber, manager of special projects for Hughes Aircraft Co., Los Angeles, told *Product Engineering*, "Increased participation by the U.S. in developing international standards is more important than changing the measuring system; however, the relationship is very close, since almost all the International Standards Organization's standards are expressed in metric terms."

Witness: William K. Burton, manager, metric systems development of Ford Motor Co.: "Let's ask ourselves the question: Why have Europeans been more successful recently in gaining international recognition of their national standards? I think the main reason is that most countries have one strong, recognized engineering-standards organization."

Witness: Anthony J. Green, manager, engineering methods and standardization for ITT-Europe, Brussels: "The mere fact of U.S. metric conversion is a minor point in relation to the side effects such a move would have in supporting U.S. positions in international standards-making."

FIRST REPORT

Strong convictions such as these are among the reasons why the U.S. Metric Study's (USMS) first report to the Secretary of Commerce and Congress dealt only secondarily with questions of conversion to SI. This report is entitled "International Standards" (National Bureau of Standards, document SP 345–1, Government Printing Office, Washington, D.C. 20402; $1.25).

The report is the work of a USMS task force headed by Robert D. Huntoon of the NBS, and it details the conclusions the group reached, which included these: that the need for more effective international standards-making participation by the U.S. lends some support to the proposal for U.S. coversion to SI; that immediate steps by the government are necessary if the U.S. is to participate in international standards-making already in progress, and if a maximum of U.S. engineering practices and standards are to be included; that U.S. participation in such global standards-writing would facilitate conversion to SI rather than the other way round, and that SI usage in international standards does not, of itself, pose serious complications to U.S. participation.

REASONS FOR THE METRIC SYSTEM—AN INFORMAL SYNOPSIS FOR LAYMEN OF REASONS WHY THE UNITED STATES MUST CHANGE ITS SYSTEM OF WEIGHING AND MEASURING THINGS

(By Olaf Tellefsen)

ORIENTATION

It has long been a fond dream of people the world over that mankind some day may agree on a common way of measuring things. That is, to have one set of units of weights and measures, good throughout the entire world. It has long been a fond dream with little prospect of its realization; yet the trend continued relentlessly in that direction until in our time, with the economy of nations so heavily dependent upon modern technology and international commerce, a common way of sizing things and of establishing common standards has become an absolute necessity.

The system that has won out is the metric system. It was developed towards the end of the eighteenth century by French scientists who had in mind the lofty idea of creating a system "to suit all people for all time". It was natural, therefore, that France became the first nation to put it to use. But with the Treaty of the Meter, in 1875, the United States and most other industrially developed nations gave it international recognition, which meant that metric units were made acceptable for expressing sizes and quantities in international trade. Soon thereafter, it was adopted by international science as the common science as the common system in which to record data and transactions of system in which to record data and transactions of universal consequence.

From then on, it was only a matter of time until nations, one by one, discarded their old ways of measuring in favor of the new. Even Great Britain found itself compelled by circumstances to forsake the Imperial gallon, the foot and the pound and embark on a program of compulsory conversion of its industries to the metric base.

That left the United States in the position of a lone outsider in a metric world.

As anyone can understand, that is an untenable position, and for several reasons; but to work out of it presents some formidable problems.

The worst one of those is to convince the American people, and particularly American industrialists, that the immediate difficulty is not of a technical nature. It is, rather, to overcome a long established belief that our measuring system is the better system, and that the rest of the world would have done better by adopting our methods and standards. It is surprising how many Americans still cling to that belief and show no inclination to concede.

That attitude on the part of so many has made it necessary for the government to proceed slowly and with extreme caution, first to ascertain *what* to do about about the metric challenge and, next, *how* to do it.

Back in 1968, shortly after Great Britain had decided on general metrication, Congress authorized a 3 year study of the situation as it affects this country, and to make recommendations relative to what would serve its best interests. That study, officially referred to as the U.S. Metric Study, was headed by the National Bureau of Standards (under the Secretary of Commerce) and assisted by prominent manufacturers, technical societies, commercial and educational institutions. In other words, it had the benefit of the views of those who would be most directly affected by whatever recommendatons it might make.

With the Study completed, the Secretary of Commerce presented his report to Congress on August 9, 1971. It was an imposing document, consisting of 180 pages with additional supporting material. In it, he made the following recommendations:

That the United States change to the International Metric System deliberately and carefully;

That this be done through a coordinated national program;

That the Congress establish a target date 10 years ahead;

That there be a firm Government commitment to this goal.

Those were well considered and well supported recommendations—what the Government had been waiting for. Consequently the President declared a few weeks later in a public address that "this country will increase its use of the metric system over the next 10 years with virtually complete conversion as the ultimate objective".

That was a momentous decision—for this country and for the world. It closed the circle, and with one stroke made the world a 100 percent metric world, making the fond dream of the Ages finally come true.

However, to make a decision is one thing; to put it into effect is quite another.

It is true, of course, that if the United States was up against an original situation, there would be reasons aplenty for apprehension and overcaution. But such is not the case by any means. Other nations have breezed through conversion in a routine manner, finding that the most dreaded problems had a way of largely solving themselves.

The ameliorating factor is the metric system's natural appeal to practical people. As soon as they learn to use it, and to take advantage of its time-saving simplicity, they will apply all their ingenuity to get away from the cumbersome-old system. It was that enthusiasm on the part of engineers and craftsmen that helped other countries through the critical stages of their conversion to metric. Our engineers may even do a better job of it because they have more to do with and more aggressiveness. In other words, the transition to metric is likely to be far less trying than American maufacturers have assumed.

It means that metric based merchandise may appear in stores and supermarkets much sooner than expected. That will pose a quite different problem: Will the public be ready for it?

As of today, when this is written, the majority of Americans have no idea of what is in the wind. But, when informed, they cannot see that a new way of measuring and weighing things will benefit the common man in any discernible way. Contrarily, they expect utter confusion when a pound of hamburger or a yard of cloth is called something else.

Actually, to prepare the public for the coming of metrically sized and labeled goods is of immediate and most pressing concern, and it poses some formidable problems relative to how to go about it. That, at least, is how it appears to those who have not the process in operation.

Fortunately, however, there are precedents from other countries to go by—precedents which show that with the proper incentive the public will take to the metric system like ducks to water.

THE PUBLIC INCENTIVES

While canvassing a cross section of consumers for their opinion of my handbook on the metric system for laymen, I found that the average citizen was largely uninformed in regard to the reasons why we are changing our measuring system. The majority could see good sense in producing export articles to international measures and standards, but why involve the entire economy?

I tried to explain that it was a matter of keeping up with the times, and if it were worth it for other nations to change to metric it is worth it for us. That, however proved to be less than convincing. Yet, it softened the attitude somewhat and in parting I was given the following proposition: "Show me a few good reasons why we must change to metric, and I'll start using it tomorrow."

That proposition reflects the spot where the shoe pinches: It is in the area of clear advantages. Americans will always look for a fair exchange.

Thus, when the problem is properly identified, its resolution is simplified to a few directly applicable explanations.

The first reason is, of course, that the Government after an expert and comprehensive study has decided that it is most advantageous for us to change to metric. Its arguments are contained in the National Bureau of Standards' Bulletin "A Metric America" which can be obtained by writing to: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

That bulletin, however, is largely focused on what concerns industry and commerce. But it is also true that whatever will benefit those activities will benefit the general public in the long run. Conversely, when they face increasingly hard going, the public is adversely affected in many ways. Accordingly, when the Government in consultation with industry and business has found it imperative that we change to the international system of measures and standards, that should represent good reason why the public should go along.

Still, the individual citizen requires something more personal, something that affects his everyday existence, something that he can ponder and evaluate for himself. There are several such aspects of the metric question, including the ethical aspect which commonly has been overlooked during the past. I shall deal with that in the following subsection.

Only a minimum of intelligence is required to understand that a universal system of weights and measures will make ours a better world to live in. It will simplify communication between nations, facilitate exchanges of talent and labor, increase efficiency both in production and in maintenance, make more goods available at less cost.

Those are benefits which apply to humanity as a whole, but their attainment is contingent upon subscription to the universal system by all industrially developed nations. The world cannot get into its full stride until there is accord on measures and standards. Accordingly, to refuse or to procrastinate is not in the best interest of this world of ours.

That is the ethical dimension of the matter.

It is something for the individual to ponder and to evaluate for himself—One can lead a horse to water, but one cannot necessarily make him drink.

The third reason why the individual should make himself conversant with the metric system is this: Scientists of all nations use that system for all their estimates and calculations. Thus, when metric terms figure in scientific or world reports, people of other nations know immediately what is meant; but for Americans the terms must first be translated into miles, feet, pounds or gallons in order to make sense.

Think this over for a minute—Would it not broaden a person's horizon to understand the universal terms?

But the inducement that more than any other strikes home to every American is the one that affects the pocketbook.

It is only too true that metrically oriented nations prefer metrically based goods, exactly like we prefer goods that is made to our own measuring system. During the past, that did not cause us much concern because the metric nations did not have the capacity to supply the enormous world market. Most foreign consumers had to buy our products whether they liked it or not. And our exports flourished, creating a constant demand for Dollars.

That, however, is no longer so. The metric nations are beginning to match up with us, taking an increasingly larger bite of the world market, even our own domestic market. Thus, we have reached the long expected dilemma that we are buying more from abroad than we sell.

Of course, our measuring system is not the only cause for this situation; but it is one of the causes, even a major one. And it has to do with the reason why other nations turned to the metric system instead of to ours. The former is so much more facile that in many instances a saving of as much as 25% is possible, with slightly less than that quite common. It means that metric manufacturers can undersell ours with a substantial margin. Accordingly, unless we take advantage of the simpler and faster measuring system, our foreign trade may soon become a strictly one way proposition.

No nation can remain static in a changing world. And no nation can continue to prosper if it cannot compete with others.

It may sound incredible to most people that anything like that could happen to America. Yet, with the exception of a few products, it is nevertheless true that American manufacturers are losing ground at an ominous rate while foreign ones are gaining. To reverse that trend is not going to be an easy task; but, at least, one of the causes can be remedied: We can adopt the simpler and more practical measuring system and standards used by foreign products and preferred by foreign customers. But the longer we procrastinate the more ground we shall have to recover. It is as simple as that.

This is the foremost inducement to take the matter of the metric system seriously, and to reconcile ourselves to the fact that we are the ones who must change because we are the ones who are out of step.

In respect to how your pocketbook is affected, consider the following: Two years ago an ounce of gold could be bought for $33.00. At this writing, it takes $48.00 to buy an ounce. That is a drop of about 30 percent in the value of the Dollar. It is also a drop of the same percentage in the value of your savings, something you may not feel immediately, or be convinced of immediately, but the loss is already there. Retrieve it you can not; all that can be done is to halt the trend by voluntary reduction of Dollar outflow while getting our exports reoriented to suit the world market. This is something for the individual to ponder and to evaluate for himself, for America is made up of two hundred million individuals, each one as responsible for its welfare as even the President himself.

It is your move, if you wish to keep it that way.

PROJECT FOR METRIC RESEARCH, DEPARTMENT OF SCIENCE EDUCATION, COLLEGE OF SCIENCE, UNIVERSITY OF SOUTHERN MISSISSIPPI, HATTIESBURG, MISS.

METRIC EDUCATION PROGRAM

Purpose:

The purpose of the Metric Education Program is to evoke immediate action for the application of the International Metric System of measurement to education at all levels.

Immediate goals:

1. Promote the distribution of the chart, "THE MODERNIZED METRIC SYSTEM," so that it may be displayed in every classroom in the United States. (NBS Special Publication 304 or 304A).

2. Present spot announcements for radio, television, newspapers, and magazines to emphasize the educational benefits which may be expected from teaching the metric system in history, language, sociology, economics, mathematics, and science classes in all schools and colleges.

3. Distribute reprints of articles, pamphlets, and statements of educators, scientists, and other scholars on the educational uses of the modernized metric system, *le Système International d'Unités*, designated SI in all languages.

General objectives:

1. Serve as an information center on the metric system, especially on the educational applications of the subject.

2. Further research in the teaching of the metric system, including the preparation of master's theses and doctoral dissertations on the use of the metric system in education, industry, and for general purposes.

3. Publicize the opinion of some scientists that education in the metric system would be the greatest stimulus in this century to the study of science in the United States.

4. Produce original articles and pamphlets on the metric system and its applications to industry, business, education, and science.

5. Establish a library collection of books and articles on the metric system, including facilities for a lending library.

6. Prepare charts, models, illustrations, films, filmstrips, inexpensive meter sticks, and other audio-visual materials for teaching the metric system at all levels of education, with special emphasis on the elementary grades.

7. Expedite the utilization of the metric system (SI) at scientific meetings, special education programs and workshops, and technical society conventions.

8. Organize traveling information exhibits on the metric system to visit schools, colleges, fairs, and public assemblies.

9. Stimulate the formation of a speaker's bureau and a traveling lecture series in which scientists and other interested persons would be available for presenting seminar-type talks, and participating in colloquia on the educational uses of the metric system.

10. Inform social organizations and other non-science groups of the uses and advantages to education of the adoption of the metric system.

11. Arrange for in-service training programs and summer institutes in which elementary, high school, and college teachers would formulate ways of presenting the metric system effectively as the primary measurement system.

12. Encourage the conspicuous use of metric units on common household articles and industrial products.

13. Foster the use of the modernized metric system (SI) in all scientific, educational, and general interest publications.

14. Advance the use of metric units in city, state, federal, and private contracts and specifications.

15. Adopt the thermodynamic or Kelvin temperature scale, and the derived CELSIUS thermometer scale.

16. Avoid polemics—stress the advantages inherent in the modernized metric system when used as educational and practical measurement procedures.

17. Urge your groceryman to set up a display with items to be sold in "kilos" and "liters" for the education of his personnel and the general public.

18. Persuade filling station operators to sell their gasoline in "liters" and to give distances in kilometers.

19. Induce city, county, and state highway departments to erect highway signs showing speed limits in km/hr and distances in kilometers.

20. Involve yourself and your family in promoting the metric system by knowing your height and weight and temperature in metric units.

RESOLUTION NO. 2—METRIC EDUCATION

Whereas the Secretary of Commerce has recommended to the Congress of the United States "that early priority be given to educating every American schoolchild and the public at large to think in metric terms," and

Whereas the AAAS has requested the Federal Government to implement a voluntary national program of conversion, and

Whereas the AAAS has urged its members to use the metric system (SI) in their published work: Therefore be it

Resolved, That the AAAS and its individual members lend their influence to promote an active program for the teaching of the metric system (SI) as the primary system of measurement at all levels of education.

Committee on Council Affairs' revision of a resolution submitted by John M. Flowers, University of Southern Mississippi. (Approved by Dr. Flowers and by the Metric Association.)

Richard W. Mattoon,
Secretary.

U.S. Department of Commerce,
Office of the Secretary,
Washington, D.C.

The Honorable President of the Senate,
The Honorable Speaker of the House of Representatives.

Sirs: I have the honor to transmit to you the Report on the U.S. Metric Study, which was conducted by the National Bureau of Standards of the Department of Commerce.

Thousands of individuals, firms and organized groups, representative of our society, participated in the Study. After weighing the extensive evidence presented by these participants, this report concludes that the United States should change to the metric system through a coordinated national program.

I agree with this conclusion, and therefore recommend

That the United States change to the International Metric System deliberately and carefully,

That this be done through a coordinated national program;

That the Congress assign the responsibility for guiding the change, and anticipating the kinds of special problems described in the report, to a central coordinating body responsive to all sectors of our society;

That within this guiding framework, detailed plans and timetables be worked out by these sectors themselves;

That early priority be given to educating every American schoolchild and the public at large to think in metric terms;

That immediate steps be taken by the Congress to foster U.S. participation in international standards activities;

That in order to encourage efficiency and minimize the overall costs to society, the general rule should be that any changeover costs shall "lie where they fall";

That the Congress, after deciding on a plan for the nation, establish a target date ten years ahead, by which time the U.S. will have become predominantly, though not exclusively, metric;

That there be a firm government commitment to this goal.

The Department of Commerce stands ready to provide whatever further assistance the Congress may require in working out a national plan and putting it into effect.

Respectfully submitted.

Maurice H. Stans,
Secretary of Commerce.

PRESIDENT: LOUIS F. SOKOL
SECRETARY: DR. RICHARD W. MATTSON
TREASURER: FRED J. HELGREN

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Metric Association Newsletter

Vol. 6 No. 4 ---- November 1971

ASSOCIATION DEVELOPMENTS

The annual meeting of the Metric Association will be held in Philadelphia in conjunction with the AAAS meeting. The program was arranged by Col. Edward A. Munns who is chairman of our Program Committee.

PROGRAM OF ANNUAL MEETING

Monday, 27 December 1971 — Academy Room
Bellevue-Stratford Hotel

Practical Solutions to Metric Conversion

09.00 Chairman: Edward A. Munns (Colonel, USAF Retired, Vice President, Metric Association, Berryville, VA)

Background, History and Current Status of Legislation, Richard W. Mattson (Secretary, Metric Association, Abbott Laboratories, Research Div., North Chicago, IL)

Canadian Metrication Experience, Albert J. Mettler (Secretary, Canadian Metric Association, Fonthill, Ontario, Canada)

Planning, Coordinating and Timing the National Conversion, Jeffrey V. Odom (U.S. Metric Study, National Bureau of Standards, Washington, DC)

Industrial Conversion, Kenyon Y. Taylor (President, Beloit Tool Corp., South Beloit, IL)

13.30 Chairman: Edward A. Munns

Conversion in Formal Education, Cornelius Wandmacher (Dean, College of Engineering, University of Cincinnati, Ohio) and John M. Flowers (Chairman, Project for Metric Research, Department of Science Education, University of Southern Mississippi, Hattiesburg, MS)

Political Considerations in Metric Conversion (Speaker to be announced)

Consumer Education and Awareness, Margaret Dana (Consumer Relations Counsel, Research Center, Doylestown, PA)

Small Business Conversion, Carl A. Beck (President, National Small Business Association, Washington, DC)

Discussion, Louis F. Sokol (President, Metric Association, Arlington Heights, IL)

Business Meeting, Louis F. Sokol

19.30 Chairman: Richard W. Mattson

British Metrication Experience, Three 16 mm sound films will cover this topic.

All MA members and other interested persons are invited to attend this meeting which is expected to be very interesting and informative. Reservations for hotel space in Philadelphia should be made early.

The week of 26-30 July was "Metric Education Week" on the campus of the University of Southern Mississippi. The program was arranged by Dr. John M. Flowers of the Dept. of Science Education and a vice president of MA. Included in the activities was a talk by Steve Hillenbrand from NASA, Marshall Space Flight Center along with a large metric display.

Dr. George Arnold, who recently retired from the faculty of Southern Illinois University, had a very thorough report on the meeting of the Engineers Joint Council which took place in New York on 3 May. The report was published on pages 422-423 of the July 1971 issue of Journal of the Air Pollution Control Ass'n.

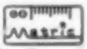
We acknowledge the following new corporate members and thank them for supporting the MA:
Pelouze Scale Co. (Bob Fisher, Pres.)
1218 Chicago Ave., Evanston IL 60202
Sterling Manufacturing Co.
Div. Scientific Scale Corp. (Peter P. Saunders, Pres.)
Mansfield, MA 02048

The Speakers Bureau, announced in the May Newsletter, is now functioning. If you would like to be included as an available speaker on metrication, or if you need a speaker for a meeting, please contact the chairman, Anton K. Rappold, 5100 N. Marine Dr., Apt. 8F, Chicago, IL 60640, (312)275-6715. Mr. Rappold will try to make the appropriate arrangements.

A press release has been sent to newspapers in the New England states announcing formation of the New England Region of MA under the direction of Adolf W. Arnold, President of Engineered Advertising. Mr. Arnold has named Philip A. Thomas to serve as administrative secretary. Activities such as meetings and use of technical library will be announced later. Interested persons can contact Mr. Arnold at 710 Turnpike St., Stoughton MA 02072.

On 16 Aug. Rocky Mountain Region Director, Frances Laner, appeared on the Channel 7, CBS News program in an interview report with Fred Hobbs during which the impact of the metric changeover as it affects various areas was discussed.

A long time member of MA, Christian J. Arnold of Mankato MN, has published a series of eight articles on metrication which appeared weekly during August and September in the Mankato Free Press. Mr. Arnold, who is a retired teacher of mathematics, presented a very extensive and thorough picture of the metrication problem in his articles.



LAPEL PINS are now available for all persons interested in promoting metrication. The distinctive red, white and blue pin was designed by James F. Anderson of Burnsville, MN and a vice president of MA. The 10 x 20 mm pins are $1.00 for 3 or $4.00 for 10 pins.

For the benefit of our new members I would like to remind them that MA is strictly a voluntary organization with no paid employees. This will account for the occasional delays in responding to correspondence by the officers and the publishing of the Newsletter. We must first attend to our "bread and butter job" before our MA activities.

Adams Tool & Supply Co., a corporate member of MA, has opened a Metric Information Center in their office at 1630 W. Armitage Ave in Chicago, IL., according to Jay Salomon their president. Persons in the Chicago area can obtain free information on metrication at the Center between the hours of 09-16.30.

Last May the Los Angeles Chapter of the Society for Technical Communication had a dinner meeting featuring the metric system. Valerie Antoine, a vice president of MA arranged to have Joanne Lynn participate as "Miss Metric." Miss Lynn appeared on several TV programs promoting the metric system, and her photograph even made the financial page of the Los Angeles Times of all places. Miss Lynn is an avid SI proponent. "I learned something about metric units in college," she says, "and insist on giving my 'vital statistics' as 89-58-89, 170 cm tall and 53 kg.

EDITORIAL COMMENT

Interest in metrication is increasing at an expanding rate. Secretary of Commerce Maurice H. Stans' report to the Congress on 30 July recommending that the U.S. change to the metric system over a 10-year period has been a major factor for this interest. It is no longer a question of whether we should adopt the metric system but one of how and when.

There now remain two major steps to be taken before the U.S. joins the rest of the world as a nation using the metric system in its commerce and industry. The first is approval by the Congress for a planned, coordinated, national program of metrication. The second is the planning and execution of such a program by a responsible government agency in cooperation with trade associations and professional societies. The use of the International System of Units (SI), that is the metric measurement language, should of necessity be made mandatory in commerce; but the development of engineering standards should remain the voluntary prerogative of industry through their standards making bodies, primarily the American National Standards Institute (ANSI). The U.S. must increase its participation in the development of engineering standards in the technical committees of the International Organization for Standardization (ISO).

In the Senate now is Senator Pell's metric conversion bill, S.2483. In the House is a resolution calling for adoption of the metric system, H.Con. Res. 389, introduced in August by the late Rep. James G. Fulton. Letters to your senators and representatives supporting metric legislation are recommended.

With the Christmas season just around the corner, many of us are faced with the task of selecting gifts for our family and friends. I would like to suggest that any of our training aids would make lasting gifts which would serve to educate the recipient in the use of metric units. None of our training aids are encumbered with customary units; they do a good job of teaching one to THINK METRIC.

In the August Newsletter the spelling "metre" was used, since I believed the National Bureau of Standards had adopted that spelling as reported on page 5 of NBS Special Pub. 330, The International System of Units (SI). Dr. John N. Howard, editor of Applied Optics and a vice president of MA took strong exception to that practice. I checked with NBS, and they stated that no official position had been taken and that either the "metre" or "meter" spelling are acceptable forms. In view of this I have decided to use the "meter" spelling until and if the official policy is changed.

Louis F. Sokol

EDUCATION AND THE METRIC SYSTEM

Reading of the 13 individual reports of the just completed U.S. Metric Study is a must for everyone who is concerned with the problem of the metric changeover. One of the major conclusions reported by Secretary Stans was, "That early priority be given to educating every American schoolchild and the public at large to think in metric terms."

For this reason every teacher, school administrator and school board member should read a copy of the Metric Study Report, Education. Following are some of the comments from that report:

When U.S. goes metric the chief educational needs will be for new instructional material. In a 10-year conversion period, together with national guidance for book publishers and school boards, we should be able to replace most textbooks, library books and encyclopedias at essentially no added cost over normal operations, either to local school districts or to textbook publishers. Teachers should spend 8-15 hours on inservice training learning the metric system and some teaching tactics. Many school districts have existing inservice training programs of this extent, and in this context there would be no extra cost. The rethinking of purpose and obligation which might accompany such a change should be considered a benefit of metric conversion rather than a cost.

One of the advantages of the metric system is that the teaching of decimal fractions, now much delayed, must occur earlier while much of the customary drill in common fractions could be reduced. The tasks of teachers in schools and those engaged in industrial training will be made easier when it is evident that the adoption of metric measurement is not a classroom discipline but a major change affecting every aspect of national life.

BRITISH METRICATION PROGRESS

Two very successful national conferences organized by the Metrication Board were held in July. The first brought together the producers of all the major industrial materials -- metals, timber, paper, chemicals, plastics, service industries, printing, electricity, gas and coal. The second covered all the disciplines in the building and civil engineering industries from architects through suppliers to on-site contractors. The construction industry has been in the lead of industrial metrication since planning started in 1966. Both conferences demonstrated very considerable progress in those two important sectors. A third conference covering manufacturers, stockists and users of key items was held in early November.

Britain's jewelry industry will begin using the gram instead of the troy ounce for all precious metal transactions 1 Jan 1972.

"Every measurement from the clay model stage of a new car to the final prototype is now fully metricated," said Ford's Director of Car Engineering, Allen Aitken.

Metric Information Service, a color coded newsletter on metrication developments in the U.K., is published bi-weekly by Revipress Ltd, 8-10 Parkway, London N.W.1. Subscription information can be obtained directly from them.

RECOMMENDED REFERENCES

Branscomb, Lewis M.: The U.S. Metric Study. The Science Teacher, Nov 1971, 38(8):58-62.

French, George T.: The challenge of metrication. Automotive Engineering (SAE J. of) Sep 1971, 79:64-67.

Mount, Robert L.: Metrication could be a blessing --- Exposes need for standardization. Quality Management & Engineering, Sep 1971, 10:18-21.

The mounting pressure to go metric. Business Week, 24 July 1971, :54-55.

METRIC HANDBOOK FOR HOSPITALS

A 14-page booklet under the above title was just published by MA for use by nurses and medical technicians. A few hospitals in the U.S. are completely on the metric system, while the remainder use metric units to varying extent. The handbook is intended to serve as a guide to the correct use of metric units and symbols, and it also contains recommendations on the steps which should be taken by a hospital to metricate its operations. Ordering information is listed.

GALLUP POLL SHOWS METRIC SWITCH GAINS FAVOR

A Gallup survey made in August shows a gain in favoring a metric changeover from a similar poll made in 1965. However, the latest survey shows the public is far from prepared for a changeover.

To the question, "Do you know what the metric system is?" Those answering "yes" are as follows:

1965 . . . . . 29%   1971 . . . . . 44%

To the question, "Would you like to see the U.S. adopt the metric system?" The results based on the aware group are:

	1965	1971
Yes, favor	37%	42%
No, oppose	46%	42%
No opinion	17%	16%

EDITORIAL FROM SOUTH AFRICA

The following appeared in the October issue of South African Metrication News:

Positive attitude - - - It is always laudable when society accepts a system which makes life easier in the sense that less effort is required to attain more. History has many examples, such as in the field of transport. Man progressed from a primitive being on foot to the modern being utilizing the wheel, steam power, internal combustion engines, jet propulsion and nuclear power for transport purposes.

Man advanced by the power of thought, continually creating short cuts, even in the very thought process itself. And now there is metrication and with the exception of the USA, the worldwide acceptance of the SI. But acceptance is not knowledge, and without knowledge, any tool however wonderful, is worthless and an unnecessary expense.

Let us guard ourselves against such a happening in the application of the SI. What is needed most now is a positive attitude; we need to put aside a little time to familiarize ourselves with the SI so that application of metric units in our everyday lives becomes automatic.

The use of the imperial system of measurement in any sphere, particularly in everyday life, is unnecessary. With only a little positive effort, you can think metric an hour from now.

****

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Wooden METERSTICK: 5 or more 50¢ each.
1.5 m flexible MEASURING TAPE: 50¢ each, 5 or more 40¢ each.
Indoor Celsius THERMOMETER: $1.00 for 2, $2.00 for 6.
Metric Units of Measure: pamphlet, 15¢ each, 10 or more 10¢ each.
Metric Handbook for Hospitals: booklet, 50¢ each, 5 or more 40¢ each.
Metric Supplement to Science & Mathematics: workbook, $1.00 each, 2-29 copies 75¢ each, 30 or more 50¢ each.
"GO METRIC" Bumper Stickers: $1.00 for 10, 10 or more 40¢ each.
"GO METRIC" Lapel Pins: $1.00 for 2, 10 or more 40¢ each.
Order from Metric Ass'n. All items sent postpaid.

U.S. METRIC STUDY REPORTS

Following is a complete list of the U.S. Metric Study Reports which were presented to the Congress by Secretary of Commerce by Maurice H. Stans on 30 July. They can be ordered from the U.S. Government Printing Office, Washington, DC

International Standards, NBS-SP-345-1 $1.25
Federal Government; Civilian Agencies, NBS-SP-345-2, $2.25
Commercial Weights and Measures, NBS-SP-345-3, $1.00
The Manufacturing Industry, NBS-SP-345-4, $1.25
Nonmanufacturing Business, NBS-SP-345-5, $1.50
Education, NBS-SP-345-6, $1.75
The Consumer, NBS-SP-345-7, $1.25
International Trade, NBS-SP-345-8, $1.50
Department of Defense, NBS-SP-345-9, $1.25
A History of the Metric System Controversy in the U.S., NBS-SP-345-10, $2.25
Engineering Standards, NBS-SP-345-11, $2.00
Testimony of Nationally Representative Groups, NBS-SP-345-12, $1.50
A Metric America--A Decision Whose Time Has Come, NBS-SP-345, $2.25

METRIC FASTENER BRIEFING STRESSES STANDARDS

The development of optimum standards systems for items widely used in commerce and industry could be a favorable offshoot of a conversion to the metric system according to ANSI President Roy P. Trowbridge.

Speaking at an editorial briefing in August on the ANSI Special Study Committee which is working with the Industrial Fasteners Institute to develop an optimum metric fastener system, Mr. Trowbridge noted, "This particular program concerns itself only with fasteners. It seems quite likely that similar programs may well be undertaken for other standard items, designs, and features having broad use in commerce and industry. A major benefit claimed for changing the U.S. from the inch-pound-gallon system to the metric system is the opportunity such a change affords to clean up the standards practices of the past leading to improved new designs and reduction of variety. It is therefore desirable that industry, commerce and consumers take advantage of this opportunity for benefit by developing optimum standards . . ."

"The ANSI Special Study Committee was established to assure development of an optimum fastener system that will achieve two basic objectives: technical improvement and simplification. More specifically, the committee will develop a total system of mechanical fasteners which will have its dimensions and properties stated in metric units . . ."

JAMA IS GOING METRIC

The Journal of the American Medical Ass'n will publish all measurements only in metric units effective January 1973. Almost 100 years ago the ruling body of the AMA recommended use of the metric system in the Journal. Since then its articles have used an increasing amount of metric units with a mixture of customary units.

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METRICATION PROGRESS IN AUSTRALIA

The Australian Metric Conversion Board completed its first year of operations. At a meeting on 14 July the Board's chairman, J. D. Norgard, issued a statement summing up the year's work. Most of the work done has been devoted almost wholly to planning and coordinating a national metrication program which is expected to be 70% complete in 1976.

The following tentative timings for conversion in different sectors were given:
Some packaged goods in shops might begin appearing in metric sizes and solely metric mass markings from early 1972.
Primary education: Wholly in metric terms by February 1973.
Secondary education: Wholly in metric terms by February 1974.
Tertiary education (universities and technical training): 1972-73.
Weighing machines: Progressively between 1971 and 1974.
Primary industry: Production and marketing of many products, 1973.
Freight rates: mid-1973. Building and construction: 1972-76.
Automotive industry: 1972-77. Timber: 1974-75.
Steel beams, plates, rubber, aluminum fabrication: 1973.

NEW ISO BEARING STANDARD SOUGHT

The U.S. is proposing a new world standard for metric tapered roller bearings. The plan is led by Timken and endorsed by all U.S. manufacturers of tapered roller bearings, the Anti-Friction Bearing Manufacturers Ass'n and American National Standards Institute. The new proposal runs counter to existing ISO standards which have already been brought under question by two major nations.

SMALL BUSINESS PROBLEMS IN METRIC CONVERSION

On 8-9 June, hearings were held in the House of Representatives before the Subcommittee on Minority Small Business Enterprise of the Select Committee on Small Business persuant to H. Res. 5 and 19. Some very pertinent testimony on the effect of metrication to small busines was given by a number of witnesses and is contained in the published hearings under the above title.

RUST-OLEUM WATCHING METRIC PROGRESS

One of the nation's major protective coatings manufacturer, Rust-Oleum Corporation, has published an article on the metric system in its corporate magazine, The Plaid Piper. This is probably the first by a company in the paint industry. Rust-Oleum uses dual labeling for its products and is watching closely metrication developments in the U.S.

NMA PROMOTES METRICATION WITH COMPUTER

An inexpensive device for quickly and easily converting common customary units to their metric equivalents is being marketed by the National Microfilm Ass'n. On the calculator, designed specifically for the micrographics industry, are correlations for length, mass, temperature, luminance and flow rates. Price is $2.40, with discounts for larger purchases. Contact NMA, 8728 Colesvill Rd., Silver Spring, MD 20910

MACHINERY'S HANDBOOK GOES METRIC

The new 19th edition of Machinery's Handbook recognizes the worldwide move towards use of SI. Some 273 pages of the 2420 page volume contain metric units, formulas and explanations. The main metric additions occur in the "Mechanics" and "Strength of Materials" sections where clear explanations are given for use of SI units along with examples of typical problems. All SI material is printed in bold type, so it stands out from customary unit material. Complete conversion tables are also included. The $19 book is published by Industrial Press, 200 Madison Ave., New York, NY 10016.

METRIC EDITION OF SMOLEY'S HANDBOOK

Smoley's Metric Four Combined Tables is a metric version of their famous handbook to serve present international and domestic engineering and construction demands. The 1400 page $20 book contains the following tables: Logs. & Squares, Slopes & Rises, Log. Trig. Tables and Segmental Functions. It is published by C. K. Smoley & Sons, Box 14, Chautauqua, NY 14722

CGPM APPROVES SI ADDITIONS

The 14th General Conference of Weights and Measures which met in Paris in September approved the following three additions to the International System of Units (SI).

The mole (mol) has been added as the seventh base unit of the SI. The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilograms of carbon 12. (When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.)

The name, siemens (S), has been given to the unit for conductance, the ampere per volt (A/V).

The name, pascal (PA), has been given to the unit for pressure, the newton per square meter (N/m^2).

RESEARCH CENTER INTRODUCES METRIC

The Langley Research Center in Virginia has started a metric system familiarization program for all of their employees, according to James Mayo, Systems Engineering at LRC. All employees are being equipped with conversion tools, instruments and scales. Lectures and courses will be conducted using M.J.B. Jones' textbooks, Working in Metric Units and A Guide to Metrication. They have also started compiling a metric design and manufacturing manual.

ZAMBIA MOVES TOWARD METRIC

The African nation of Zambia is well along its metrication road. They have issued several metric publications for free distribution to their citizens. As a further means of indoctrinating the public to metric units, they have produced an educational game, "Go Metric," which can be played by two to six players.

KEEP UP WITH THE PROGRESS OF THE UNITED STATES TOWARD THE ADOPTION OF THE METRIC SYSTEM. THE NEWSLETTER CONTAINS THOUSANDS OF DOLLARS WORTH OF INFORMATION FOR ONLY $2 PER YEAR. SEND IN YOUR MEMBERSHIP REQUEST NOW!!!

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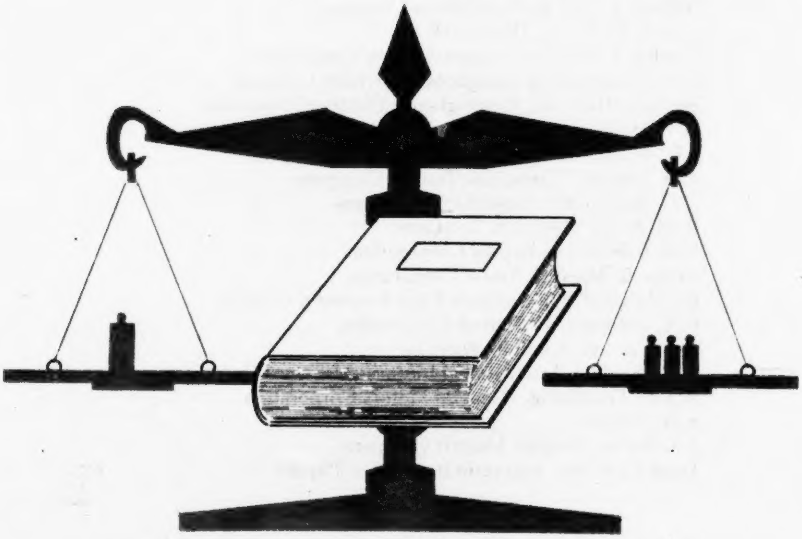
antitrust implications of metric conversion



a study by the American National
Standards Institute

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1 - 9 copies	$2.00 each
10-49 copies	1.60 each
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Above 100, discount prices on request

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Introduction

As a part of its continuing program of providing an objective industrial viewpoint in this nation's current metric studies, the American National Standards Institute prepared this analysis and report of antitrust implications of a coordinated metric conversion under contract to the National Bureau of Standards.

The study contains an analysis of problems which may be encountered under a number of varying recommendations which may emerge from the NBS study and subsequent report. Because the term "coordinated national program" has not been defined, three different hypothetical assumptions have been made for purposes of this report.

ANSI has recommended a course of action which it believes would reduce the practical difficulties which may be inherent if a national coordinated program for conversion to the metric system is undertaken. Paramount among the recommendations is continued full use of the autonomy and dynamic strength of the voluntary standardization process under the Institute's programs and procedures. It further recommends that a single government-industry partnership agency be appointed and designated by Congress as the focal point for such a program.

A legislatively structured, and perhaps novel, system of resolving conflicts is recommended, involving industry-by-industry arbitration.

The report has been prepared by a panel of experts from the ANSI Metric Advisory Committee with the participation and advice of Institute legal counsel as well as staff counsels of a number of panel participants. No attempt has been made to achieve consensus of ANSI members on its provisions or recommendations.

The report has been submitted to the director of the U.S. Metric Study of the National Bureau of Standards. It has not been endorsed by, nor does it represent the views of, the Department of Commerce or any other agency or department of government.

With permission of NBS, ANSI is publishing and making available the report in the interest of providing an opportunity to all interested and affected parties to study, discuss, and debate its recommendations.

Roy P. Trowbridge
President

[illegible]

An analysis of the antitrust implications of a changeover to the metric system (SI) calls for consideration of three very complex subjects. They are: (1) metric conversion itself; (2) the engineering standards development process; (3) compliance with the antitrust laws.

This complexity is compounded by the need for extensive interindustry communication in the standards development process, under an as yet undefined "coordinated national program of metrication." Since the "coordinated national program" has not been defined, for purposes of this report three different hypothetical assumptions have been made as a basis for the analysis of potential problem areas.

Possible Action on Conversion

If Congress determines that it is in the best interests of this country to expand the use of metric units of measure (SI), to the point where metric becomes the predominant measuring system in the U.S., it could then—

1. Legislate a mandatory government program of complete metric conversion with a time limit for completion applied to all industry, commerce, and trade; or

2. Assign an agency of the federal government the responsibility to assist, commensurate with available federal funds and technical manpower: (a) in the conversion of all or part of the activities of industries, companies, organizations, and individuals in both the public and private sectors to the use of metric units of measure and (b) in the development and implementation of new metric engineering standards. The program would be voluntary, but require establishment of definite timetables for conversion of various sectors of the economy. These timetables would be subject to regular review and updating as progress is made in conversion; or

3. Same as (2) above, except that there would be no requirement to establish time-

tables. Instead a mandate would be given to the agency to investigate and recommend appropriate time schedules for various segments of society.

Standards and Standardization

Development and implementation of new metric standards, mentioned above, will be an important step in metric conversion. The following definitions of standardization and standards may be helpful in dispelling confusion that sometimes prevails on these subjects.

Standardization

The process of formulating and applying criteria for an orderly approach to a specific activity for the benefit and with the cooperation of all concerned and in particular for the promotion of optimum overall economy, taking due account of functional conditions and safety requirements.

It is based on the consolidated results of science, technique, and experience.

It determines not only the basis for the present but also for future development and it should keep pace with progress.

Some particular applications are:

1. Units of measurement;
2. Terminology and symbolic representation;
3. Products and processes (definition and selection of characteristics of products, testing and measuring methods, specification of characteristics of products for defining their quality, rationalization of variety, interchangeability, etc);
4. Safety of persons and goods.

Standards of Measure

These are official units of measure established by the National Bureau of Standards and are used in *quantifying* all aspects of our physical environment.

Engineering Standards

This term is used broadly to include all standards which establish uniform specifications for parts, materials, manufacturing and construction practices, commodities, consumer goods, and safety. Nationally recognized engineering standards are the result of consensus reached by representatives of affected parties-at-interest and are developed under coordination and administration of a recognized standards-making body. They may have company, industry, national, or international significance.

Government Regulations (sometimes called standards)

These are made mandatory by law or regulation which requires compliance with their provisions by citizens, companies, industries, or commerce. They may be based wholly or in part upon existing engineering standards. Government utilizes thousands of standards both for procurement of goods and services and as a basis for legislatively authorized public programs such as health, safety, defense, and transportation.

Specifications for Certification

These, like government regulations, may be based wholly, or in part, upon existing engineering standards. However, in certain cases where engineering standards are too tightly structured to give the flexibility required for certifying products, unique specifications must be prepared to prevent dilution of the integrity of the engineering standards.

General Analysis of Antitrust Implications

The present pace of engineering standards development, under ideal conditions of completely voluntary participation—at times a lengthy process—tends to be delayed by observance of the necessary safeguards against anticompetitive effects. Review by coordinating authority of the many participants in standards work drawn from all segments of industry may appear to retard the development process during the period of communication and collaboration needed to develop good consensus standards. Such review is necessary, however, to provide protection and incentive for uninhibited participation in standards development.

Since new engineering standards must be developed and promulgated before any meaningful progress toward metric conversion could be accomplished, any nationally coordinated metric conversion program that contains mandates of acceleration or time limits would result in engineering standards development *crash programs*. Under these conditions product manufacturers and the thousands of suppliers of standard parts and materials could be subject to risks of exposure to antitrust violations in direct proportion to mandated standards development activity.

The establishment of target dates, as in Assumptions 1 and 2, will require not only deadlines by which 20,000 or more engineering standards having national significance must be restated in, or converted to, metric, but will also require follow-on timetables of implementation. Manufacturers of materials and standard components must meet the deadlines for use of their products by those industries which are dependent upon them. These industries must in turn be informed of the timetables established for parts and materials suppliers. During the period from initiation of the metric program to its implementation by industry, all companies and organizations must carry out a program of redesign, retooling, and training of personnel. Metric conversion would, of course, not be across the board at start-up. It would proceed in reasonable steps to avoid unnecessarily early obsolescence of products or tools. Such a program would be complicated, however, by the need during the changeover period for all affected companies to work to standards of measure and engineering standards in both metric and customary systems.

Assumption 1 presupposes that the establishment of mandatory timetables would be the responsibility of a government agency empowered to carry out the program in close cooperation with the affected producing and using industries and in consultation with general consumers and affected governmental agencies. It would seem appropriate that a policy board be established having representation from the government, industry, commerce, and the public, under which would operate task groups having appropriate balanced representation aimed at specific segments of industry and commerce. No doubt cross-liaisons between these task groups would be established to coordinate the final timetables.

Target dates will, of course, be set first for the necessary engineering standards. Problems of variety reduction, selection of standard configurations, or performance requirements may not receive unanimous consent under the accelerated pace at which such a program would be carried out. Obviously, it is impossible for all manufacturers, users, and consumers to vote objectively on approval of an engineering standard affecting their particular interests. A public review process would no doubt be required to assure an opportunity for all to air their views. Nevertheless, an individual firm or even an entire industry could feel that the proposed or accepted standards are arbitrary and that they foreclose options the dissident groups would have preferred. In normal voluntary standards development, such objections occasionally arise. The lack of a hard and fast timetable, however, allows for an indefinite period of dialogue and possible accommodation.

Although government action on certain controversial engineering standards proposals might provide solutions under a mandatory metric conversion program, it is almost certain that many of the standards in question would not be feasible or appropriate subjects for regulation. Thus, there would be a strong chance that, if the timetables are maintained in spite of objections, aggrieved parties would seek redress in court action. In Assumption 2, with the timetables subject to revision, the policy group and task groups could reset target dates and make necessary adjustments within and between various sectors of industry and commerce. Under Assumption 3, with its even more flexible approach, there is not likely to be any substantial increase in such objections over the current rate.

Under any of the three assumptions, it would seem desirable for the policy group mentioned earlier to accord a major coordinating role to a national voluntary standards organization used by the many professional and technical societies and trade associations which are the administrators for development of engineering standards and from whose ranks the technical personnel for developing the standards are furnished. Availability and full, efficient use of such a national standards coordination body would greatly enhance any metric conversion program. It would make it unnecessary for the federal government to undertake the standards development coordination task. It would also preserve the strengths inherent in the voluntary standards processes, particularly the ability to marshal and organize the total required competence. It is recommended that metrication legislation and any programs contemplated to implement conversion make full use of the autonomy and dynamic strength of the voluntary standardization process.

The most sensitive area of antitrust exposure in a mandatory or voluntary coordinated metrication program lies in establishing dates for implementation. If a coordinated program is to be effective, companies which supply materials and parts must have these parts and materials in the marketplace by the scheduled dates. Companies which use these parts and materials must be ready to place orders for them by the target dates. The very act of groups of companies reaching agreement on such target dates could raise questions under the antitrust laws.

Even though careful procedures might be followed, including public announcements and time for comment for those companies or industries who were not in agreement with the selected target dates, the latter might feel that they had been penalized and had a legitimate complaint against those companies that had established and agreed upon the target dates.

Problems could arise between the suppliers and users of parts and components, not only through failure to accept the target dates, but also through failure on the part of the user to fulfill his obligation to purchase materials and components which had been readied for availability by the target date. Because mandatory as well as voluntary programs could be disruptive to the normal business relationship between groups of companies, Congress should consider enacting limited antitrust exemptions covering compliance with time schedules for conversion.

It would seem that not only would individual companies be exposed to considerable antitrust risks, but the standardization bodies themselves could also become parties to any litigation which might develop as a result of scheduled programs. Such risks could in degree far exceed those present under voluntary programs which establish no mandatory effective dates for compliance. It is urged that the metric study of the National Bureau of Standards and the subsequent report to be presented by the secretary of commerce to Congress carefully consider the compatibility of the antitrust laws with their final recommendations.

A legal analysis of antitrust law implications of coordinated industry metrication follows.

Legal Analysis of Antitrust Implications of Coordinated Industry Metrication

What will be the impact of the antitrust laws on planning and implementing a coordinated national program of metrication, in the event the Congress should determine that conversion to the metric system is in the public interest?

One premise of this analysis and these recommendations is that Congress, in the course of its determination to embark on a national program of metrication, would designate as the focal point of the program a single governmental board or a single government-private sector partnership agency (the "Board") with a legislative mandate to guide and coordinate the conversion program under an appropriate time schedule.

The conclusions reached are:

1. Substantial antitrust problems would be posed by joint industry[1] efforts to implement metrication in many, but not necessarily a majority, of affected industries. The traditional antitrust safeguards that ordinarily insulate participants against risks of antitrust exposure in analogous private joint activities may well prove inadequate to meet the special competitive problems presented if the timing and method of conversion were to raise serious conflicts of commercial interest.

2. In the rest of the industries affected the competitive effects of conversion under a reasonable (voluntary or mandated) time schedule would probably be neutral to the extent that all industry members concerned are afforded equal opportunities to adjust and all bear some costs and achieve some advantages without significant effect on their competitive positions. This condition would prevail only to the extent that the process of conversion itself did not harm the kinds of competitive and consumer interests the antitrust laws are designed to protect. Protection of these interests would require scrupulous adherence to the traditional antitrust safeguards and to principles of private due process so that voluntary conversion efforts could be accomplished without antitrust pitfalls.

3. A legislatively structured, and perhaps novel, system of resolving conflicts is needed to meet the competitive problems described in Conclusion 1. Required would be a system of industry-by-industry arbitration panels appointed by the Board whose determinations would not be subject to antitrust challenge. Where serious conflicts of interest arose and were not susceptible to a compromise solution, the determination reached could well involve a significant competitive disadvantage to a particular firm or group of firms. In these cases such panels should be accorded authority to recommend "adjustment assistance" to the Board to prevent increases in concentration of the market structures of particular industries that could result from metrication.

4. Finally, provision should be made for firms in industries where the competitive effects initially appear "neutral" to transfer the handling of their cases to the legislatively authorized panels. Thus, what is contemplated is a side-by-side system of both voluntary conversion procedures administered by experienced existing private organizations and a correlative public mechanism to administer comparable procedures when irreconcilable conflicts arise.

The impact of the antitrust laws on joint industry standardization activities has been remarked at length in major addresses or written opinions by the present leading antitrust enforcement officials, by their predecessors, and by the senior staff members of the Antitrust Division of the Department of Justice and the Federal Trade Commission. The criteria for conducting such activities under the antitrust laws, as expressed in these statements, are instructive and relevant to joint industry activities contemplated for implementing metrication. These criteria are specifically germane to the voluntary standards efforts that would be needed to rationalize engineering practice.

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[1] "Industry," as used herein, means suppliers, distributors, and users, as well as producers.

Antitrust enforcement attitudes on the legality of standardization generally, the specific antitrust dangers involved, and the safeguards to be applied to minimize such dangers are illustrated by the following statements:

> Cooperative industry efforts to establish standards are not, in and of themself, violations of the antitrust laws. The Department of Justice recognizes that standardization can enhance competition and result in a more efficient allocation of resources, primary goals under the antitrust laws. For example, standards which facilitate the interchangeability of parts or ancillary systems may promote competition by increasing the ability of new firms to enter concentrated markets. Knowledge that all brands meet certain minimum levels with respect to performance, may enable consumers to make cost-performance trade-off decisions in a more rational manner. In this respect, standards may lessen the influence of advertising and promotional activities unrelated to actual product differences, thereby lowering barriers to entry by new producers and increasing the vigor of price and quality competition. Moreover, the establishment of standards may serve as a means of fostering both the acceptance of technological innovation and the improvement of product performance and safety.[2]

In the same address, Mr. Grossman outlined "those implications of private standards-making activities which raise antitrust issues and thus cause the Department of Justice to refrain from 'blessing' such activity with an undiscriminating approval." He included in this category:

1. The use of private standards to facilitate restrictive agreements, including price-fixing and the elimination of nonstandard products from the market, as in the *Standard Sanitary*[3] and *Trenton Potteries* cases;[4]

2. Basing standards upon the products or production capabilities of a dominant group of manufacturers, arbitrarily handicapping smaller competitors or potential competitors;

3. Adopting unnecessarily rigid standards which may impede product improvement and innovation, thereby diminishing the vigor of existing competition and creating additional barriers to entry in industries already concentrated or evidencing a trend toward concentration; and

4. Approving standards for safety or performance which unnecessarily deprive consumers of desired purchasing options; for example, inferior but cheaper products.

This detailing of the antitrust dangers presented by private standards-making activity has recurred in statements by the present assistant attorney general in charge of the Antitrust Division,[5] by his two predecessors,[6] and more recently by the present chairman of the Federal Trade Commission.[7]

Judicial decisions in this field, as well as the pronouncements of antitrust enforcement officials, have suggested the important criteria to be considered in assessing whether standards programs may run afoul of the antitrust laws:

First, the purpose of standardization must be apparent and must be legitimate. Standards which are concerned principally with commercial relations are suspect. Certainly, protection of public health and safety is a proper goal. Interchangeability, simplification to avoid needless proliferation of varieties, and the rationalization of communication between scientific personnel and between firms doing business are all goals in the public interest.

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[2] Address by Barry Grossman, Assistant Chief, Evaluation Section Antitrust Division, Department of Justice, before the 51st Annual Meeting of the American National Standards Institute, November 20, 1969.

[3] 226 U.S. 20 (1912).

[4] 273 U.S. 392 (1927).

[5] Letter dated June 17, 1969, from Richard W. McLaren to Arnold B. Elkind, chairman, National Commission on Product Safety.

[6] Address by Donald F. Turner before the Antitrust Law Section of the New York State Bar Association, January 26, 1967; letter dated November 27, 1968, from Edwin M. Zimmerman to Malcolm W. Jensen, chief, Office of Weights and Measures, National Bureau of Standards.

[7] Remarks of Miles W. Kirkpatrick before the Antitrust Law Section of the New York State Bar Association, January 28, 1971.

Second, the standards-making process should be available to all parties at interest and should assure representation of consumers and independent experts, as well as producers. The wisdom of conducting open proceedings rests partly on judicial decisions that private standards organizations have the responsibility to accord concerned interests timely notice and a hearing—the minimal attributes of due process—before promulgating standards, which although reasonable, may operate to the disadvantage of such interests.

Third, the decision whether to produce, sell, or service standard or nonstandard products must be left to the voluntary discretion of individual competitors. The law does not tolerate sanctions imposed by agreement among competitors whether against members of the same trade, or their suppliers or customers.

Fourth, there is a strong antitrust-oriented preference in favor of standards written in terms of performance rather than standards designating materials and specific constructions and in favor of standards which promote information on comparative values through grading criteria rather than single criteria, pass-fail specifications.

While adherence to these safeguards would undoubtedly serve to protect most private standardization efforts undertaken in connection with a national program of metrication, there is one circumstance noted consistently by present and former antitrust officials where it is unlikely that voluntary private standards efforts to implement metrication could avoid significant antitrust problems. This circumstance occurs when serious conflicts of economic interest are posed—either among competing manufacturers, or between manufacturers and parties with whom they deal. As noted by former Assistant Attorney General Turner:

> The more the conflicts of interest, the more likely that private group action will either harm the kind of competitive and consumer interests which antitrust law can protect, or simply prove inadequate for establishing the kind of standards that the public interest would dictate. I realize of course that legislation, with or without implementation by an administrative agency, is not without problems of its own. But it is the only appropriate solution where serious conflicts of interest are involved . . .[8]

Under the voluntary system of standardization based on principles of consensus, serious conflicts of interest can be and have been resolved by compromise solutions without injury to competition. This is accomplished in the best of private standards-making systems by the prodding, persuasion, and diplomacy of senior boards without commercial interest in the specific issues presented. The procedures of the present leading standards organizations, however, require that no standard be approved if consensus is still lacking after efforts to resolve conflicts have been made. In a national metrication program the necessity of interindustry coordination suggests a mandated time schedule, however flexible, imposing certain final deadlines. As such deadlines approached, the present option in a voluntary system of publishing no standard, as a last resort in cases of persistent conflicts, would not avail and would seriously hinder conversion efforts. Thus, a proposed standard, after full review and consideration of alternatives could appeal to a majority of industry members as optimum and to disinterested reviewers as in the public interest, even though certain producers, users, or others remained adamantly opposed. Where serious disagreement persisted and the commercial stakes were high, the exposure to private antitrust treble damage claims, even though ill-founded, could well diminish the willingness of competent personnel to volunteer the efforts on which an expeditious metric standards program would depend.[9]

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[8] See Footnote 6.

The special antitrust problems uniquely attributable to metrication, or which would be magnified by it, include difficult questions of timing, or effective dates of the recommended engineering practices involved. Varying schedules of machine tool replacement, varying capacities to cope with dual inventories, during periods of necessary overlap in the conversion process, and fortuities in the timing of research and development results could be expected to give rise to significant conflicts.

In a hypothetically structured fire-plug industry, for example, it is possible that a firm with many years investment in development of a spray device for summertime relief of sidewalk heat would be perfecting its patent claims and planning to initiate marketing of the device at about the date when metric standards for new fire-hose couplings were planned to be implemented. If the patented device did not readily interface with new metric fire-plug fittings or with devices intended to adapt existing fire-plugs to the new hose couplings, the producer of the spray device would surely feel aggrieved. Any action of producers of fire-plugs, their suppliers, or the municipalities comprising the users which resulted in adoption of standards precluding use of the patented device could be challenged by the patentee as an attempt to boycott its product. On the other hand, a standard intended to accommodate the patented device, possibly to the disadvantage of competing devices, would raise other questions of foreclosure. Whether the public interest in efficient, safe, and interchangeable fire-fighting equipment, the participation of the municipalities, and the strict observance of the antitrust safeguards outlined above would insulate the defendants in such a suit are questions on which the last word of case law has not been spoken.[10]

Given the limits of any hypothetical construct for antitrust analysis, it would serve no useful purpose to attempt to foresee the various possibilities for serious conflicts of interest that might be uniquely associated with conversion. But it is apparent that certain suppliers in the standard parts and materials industry serve both dominant and peripheral customers. It is also apparent that overseas sources of metric parts may only be available to competing producers on unequal terms. The likelihood exists, therefore, that any proposed effective dates for implementing new engineering practice will be unacceptable to some interests for a multitude of reasons.

In cases presenting serious conflicts of interest not capable of reconciliation under present voluntary standardization systems, it is recommended that disposition be assigned to an arbitration panel appointed by, and operating under procedures promulgated by, the Board. These procedures should include notice to all parties through Federal Register publication, a hearing, and disposition by majority vote of the panel with a single right of appeal to the Board itself. Of course, judicial review of the Board's decision would be available. In the event no appeal is taken, the panel's determination should, nevertheless, be reviewed as a matter of course for procedural fairness, coordination with related industries' actions, and assessment of competitive effects, principally whether any less anticompetitive alternatives could feasibly be adopted in the circumstances. Upon approval after such review, implementation of the government panel's determination should be accorded express antitrust immunity. This immunity should extend to industry participants in the standards effort and nonparticipants necessarily reacting to the timing and method of implementing the conversion (but only to the extent necessary to make the determination work). Such immunity should not, of course, extend to anticompetitive activity presently held unreasonable per se or which could be shown to be unreasonable in the circumstances *and* unnecessary to the nationally mandated conversion effort.

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[9] *See Application of ASTM*, 231 F. Supp 686 (1964).

[10] Compare U.S. v. *National Malleable & Steel Castings Co.*, 1957 Trade Cases, ¶68,890 (1957), aff'd, *per curiam*, 358 U.S. 38 (1958). *Application of ASTM*, *op. cit.*; and *Whitten v. Paddock Pool Builders, Inc.*, 424 F. 2d 25 (1st Cir. 1970), *cert. den.* 400 U.S. 850 (1970).

Should comparable immunity be accorded to private standards-making efforts in industries where the competitive effects of conversion may be neutral and where no serious conflicts of interest appear? It is submitted that the grant of such immunity could only be justified on the basis of active review and regulation of the private standards-making bodies by the Board. Given the variety of procedures followed by the many organizations generating standards, any suggestion that antitrust immunity be accorded to such organizations in return for general cooperation with the coordinating agency would raise serious questions of delegation of governmental power. Experience shows, moreover, that antitrust immunity is not lightly bestowed by the Congress, nor liberally construed by the courts.[11] It is recommended that the kind of limited antitrust immunity outlined above be accorded to private standards-making activity only on condition that the private organization involved has developed and approved the standard in question under procedures meeting the same criteria as those used in the congressionally structured panels and that the private organization's determination be reviewed by the Board under the same tests as those applied to determinations of an official panel. Those private organizations adopting standards for metrication under procedures which do not meet the criteria specified could, then, offer their participants no greater antitrust protection than that afforded by the *Noerr-Pennington* doctrine[12] for joint efforts to influence legislative or executive action.

Clearly, threats of antitrust exposure which discouraged the voluntary contribution of engineering expertise at a time when it was needed most would be at odds with a national policy of metrication. No set of government agencies could muster the breadth of expertise required. At the same time, any process of conversion to the metric system which does not safeguard the interests the antitrust laws are intended to protect would be difficult to justify. Accommodation of the two purposes is feasible by reliance on neither a wholly governmental nor wholly private structure. Instead, the private structure should be used to the extent experience shows it can be used without undue risks of antitrust exposure, with a "fall-back" structure for those projects in which such risks are presented.

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[11] *United States* v. *Borden Co.*, 308 U.S. 188, 198-99 (1930); *Silver* v. *New York Stock Exchange*, 373 U.S. 341, 357 (1963); *Thill Securities Corp.* v. *New York Stock Exchange*, 433 F. 2d 264, 272 (7th Cir. 1970).

[12] *Eastern Railroad Presidents Conference* v. *Noerr Motor Freight, Inc*, 365 U.S. 127; *UMW* v. *Pennington*, 381 U.S. 657 (1965); compare *Whitten* v. *Paddock Pool Builders, Inc, op. cit.*; and *Woods Exploration & Producing Co., Inc v. Alcoa*, _____ F. 2d _____ (5th Cir. 1971).

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editorial

Go metric It sounds like a cheer, doesn't it? Well it is!

It's a cheer for editors Frank Hall and Bob Carson.

Their five-part series of articles on America's move toward metrication won a 1971 Jesse H. Neal award. The articles appeared in *Machinery* between December 1970 and May 1971. Some people consider the Neal award as business journalism's "Pulitzer Prize". Each year 15 awards are presented for the best editorials, articles, series of articles and special issues from over 500 submissions by business magazines. We are proud that a series of articles from *Machinery* was selected for this honor. In the award-winning articles series, Frank and Bob built the case for U.S. conversion to the metric (SI) system, and reported industry, labor and consumer reaction to conversion—as presented at the Bureau of Standards Metrication Conferences. At the time (November 1971) *Machinery* also took a stand favoring metrication—spread over 10 years.

I want to reiterate that position. *Machinery*, one and one-half years later still favors complete U.S. conversion to the SI system by 1985; that a national schedule and conversion plan for various industries should be developed to minimize difficulties; that any costs which accrue should not be borne by the government, so that there will be strong incentive for industry to re-evaluate and improve its operations at the time of conversion, and that the conversion be complete so that all measures are metric.

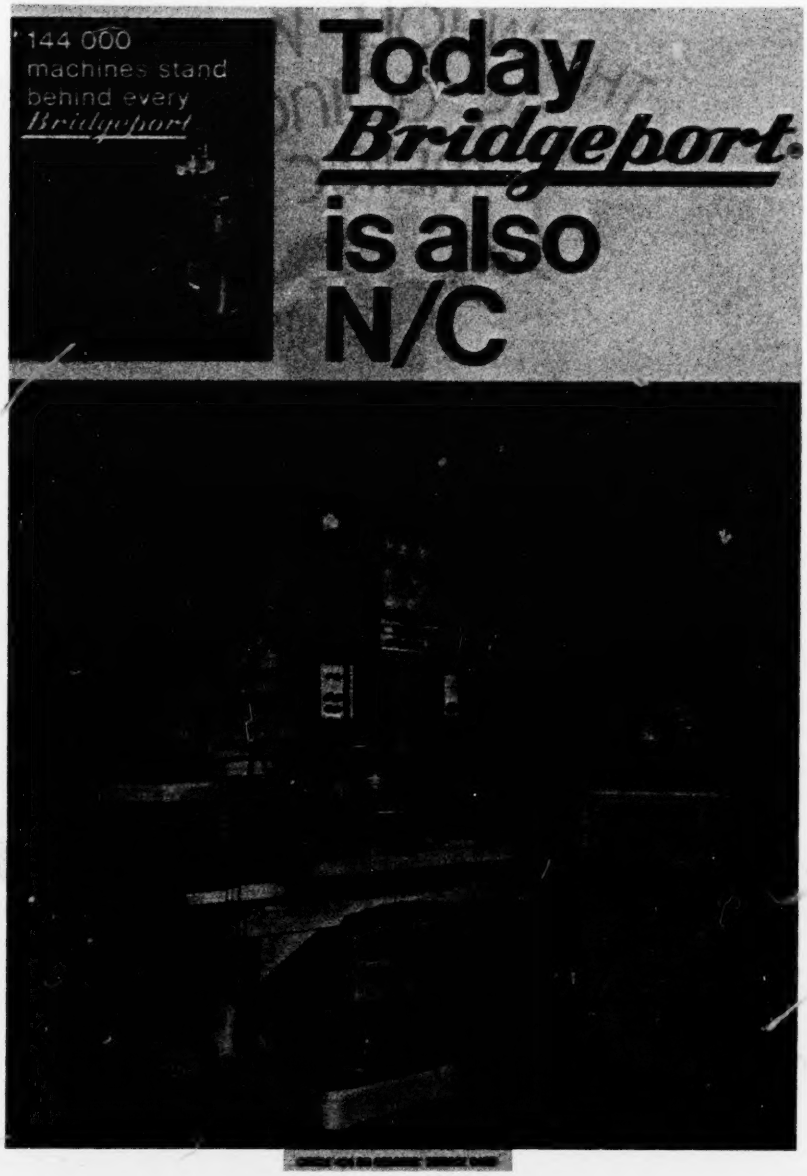
A conversion period from 1975 to 1985 allows Congress time to pass enabling legislation and time for the coordinating machinery to be formed and plans developed before the beginning of the conversion period. Industry-by-industry target schedules are desirable so that one industry doesn't design its products for metrics and then discover it can't get parts because supplier industries haven't yet begun conversion.

One of the major benefits that can result from metrication is significantly increased operating efficiency if the conversion period is looked upon as an opportunity to reexamine old methods and procedures. The need to offset conversion costs by increasing efficiency is incentive for keeping costs down. If the government were to underwrite all, or even part, of the conversion costs the incentive to find ways of offsetting them will be lost.

Complete conversion is necessary if we are ever going to learn to use the SI system efficiently. For example, one engineer I know has been using and working with the metric system on his job for over 4 years. Yet he doesn't "think" metric. He doesn't think he'll be "converted" until he's forced to use metric units 24 hours a day. When his bathroom scale reads in kilograms, speed limits are in kph and he buys milk by the liter, then he'll begin to think in meters instead of yards.

We feel that there's nothing to be gained by delaying conversion to the SI system. The longer we delay the more it will cost. So let's get busy and . . . Go Metric!

Charles Pollock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THE WHOLE WORLD IS GOING METRIC

YARD	METER
GALLON	LITER
OUNCE	GRAM
MILE	KILOMETER
INCH	CENTIMETER
ACRE	HECTARE

PLUS

[redacted]

This series on the National Bureau of Standards Metrication Conferences, which took place during the Fall of 1970, explores in some depth the opinions of representatives of leading segments of American industry. The official reporter for NBS was our senior contributing editor, Robert W. Carson who wrote the final article himself.

After the first shock—discovering that every industrial nation in the world except the U.S. is committed to metric—you soon realize that even the U.S. is partly on the metric system already, that it is slowly becoming more metric, and that the longer this evolution continues, unplanned and uncontrolled, the more painful the whole conversion process will become. So the problem becomes much broader; one that is faced by a democracy many times: can a free society voluntarily take the steps necessary to plan its growth, or must it drift into changes which although inevitable, are faced piecemeal, at much greater expense and hardship?

Frank Hall

FRANK HALL
senior editor

Metrication . . .
Let's get at it

If you look at a world map, and color in all of the nations that either use the metric system or are firmly committed to conversion, you'll be shocked. The U.S. is the only industrialized nation still committed to "English" units. Even the English have abandoned their system.

If we made everything we use and sold none of our products overseas, our dimensional isolation wouldn't make any difference. But we do trade with other countries and our adherence to an irrational system of weights and measures based on barleycorns and horses puts us at a disadvantage in world markets. And this is a disadvantage we cannot afford.

It is becoming increasingly apparent that the directions of commerce are toward expanded and freer world trade. Though the U.S. could survive for some time if it were isolated from the mainstream of world trade the final result would probably be similar to the effect of nationalism upon the empires of the 19th century—we would eventually have to change, under duress and with heavy economic loss because we hadn't maintained our position of leadership.

Presently, the National Bureau of Standards, at the request of Congress, is conducting a National Metric Study to determine the advantages and disadvantages of increased use of the metric system in the U.S. This study has many facets: surveys of manufacturers, cost analyses, import-export patterns, effects upon consumers and workers, and the impact of metrication.

One of these facets is a series of seven National Metric Study Conferences to give representatives of major trade associations, professional societies and similar groups an opportunity to express their views on metrication. The first of these conferences was held recently. It was open to representatives of engineering-oriented industry such as: AIME, SPI, ASTM, ASME, SAE, ASHRAE, NMTBA and NEMA.

The views expressed ranged from "who needs it" to "what are we waiting for." In general, the trade associations leaned toward the former view while the engineering societies leaned toward the latter.

Industries with little export opportunity felt that conversion would increase costs and give foreign competition more opportunity in the U.S. market. However, even those representatives felt that a change to the metric system seemed inevitable.

Those industries already participating in world markets favored prompt conversion. In many cases, companies with foreign subsidiaries are already using dual metric/English dimensions on drawings and literature.

Some industry groups pointed out that a well-planned, well organized conversion program would not be as expensive as many people think. New metric equipment and tools could be phased in as existing equipment is replaced.

Most of the technical societies at the conference are already involved in active metrication programs. Most of these societies are already using metric equivalents along with conventional units in their publications—with the metric units preferred in many cases.

Wider U.S. participation in the work of ISO (the International Standards Organization), regardless of whether or not we convert to the metric system, was urged by most of the attending groups. One reason—besides a more orderly international standards system—is the growing use of ISO standards for product certification. Since these ISO standards use only metric units they will, in effect, erect nontariff barriers to U.S. products unless we take an active part in the development of new ISO standards.

New metric standards must be developed in preparation for a changeover. Only about 1/5 of the required international standards have been prepared. Clearly, there is a definite need for standards work and U.S. industry, with its experience and fairly complete set of standards, has much to contribute to this international effort.

Experience in England where a ten-year metrication program is at the halfway point, and comments by the NBS conference attendees, has shown that there are two ways to approach metrication. One is to simply redimension what we already have. The other is to convert to "metric modules." For example, will 1-inch diameter bars simply become 2.54-centimeter bars or will industry redesign and use 2.5-centimeter bars?

The dimensional conversion is certainly the simplest. Or is it? If everyone converts to metric stock then the steel mills have to produce only one product line. However, if the U.S. merely converts dimensions the mills will be forced to carry two product lines—one for those still designing in inches and converting, and one for those that go all the way and design in the metric system.

During any changeover period it will be necessary to have dual stocks. But we hope that when metric conversion finally comes to the U.S.—and we are certain that it will—industry will see the advantage to complete conversion in all types of products without regard for their export market. Otherwise, we may end up with domestic household products still being made in inches while the machines used to manufacture them are made in meters—and then the conversion costs really would be measured in "megabucks."

Charles Pollock

We can't lick 'em, so we'd better go metric—soo

The more you dig in to problems of standards and measurements, the more obvious it becomes that we're going to go metric. Reports from the National Bureau of Standards metrication conferences show that while opinions vary from "now" to "never", a strong majority regards U. S. conversion as inevitable. The question no longer is will we, but when and how?

Frank Hall
senior editor

If you take a look at the map on the opposite page, you may be surprised to see that the only nonmetric countries in the world are Ceylon, Gambia, Guyana, Jamaica, Liberia, Malawi, Nigeria, Sierra Leone and the United States. The other 150 or so countries are either already on the metric system, or on the way. Even the British have given up the "British" system of pints, quarts, gallons, etc. and are halfway through a 10-year conversion plan to metric.

So what, you may say. We've been talking about converting to metric in this country ever since Thomas Jefferson broached the idea in 1790. But in those days, the U. S. was not an industrial nation, and was dependent on Great Britain for most manufactured goods. More recently, the U. S. was, in relation to the rest of the world, an industrial colossus and was to a great extent, self-sufficient.

Things are a little different now. We face some stiff competition throughout the world. Japan, Great Britain, and EEC (European Economic Community consisting of West Germany, France, Italy, Belgium, The Netherlands, and Luxemburg) have all become major suppliers of industrial goods to the world—and they have all gone metric. Even Canada, our close neighbor and biggest trading partner, is going metric, as well as Australia which has become a significant market for U. S. exports in the past three years.

While we still are the most technologically advanced nation in the world, we no longer call all the shots. We do not lead in all products. For example, Japan and the Scandinavian countries have taken over the lead in ship building. The lead in steel technology which we took from Europe 70 or 80 years ago is theirs once again. Our lead is concentrated in new product areas such as computers, integrated circuits, etc.

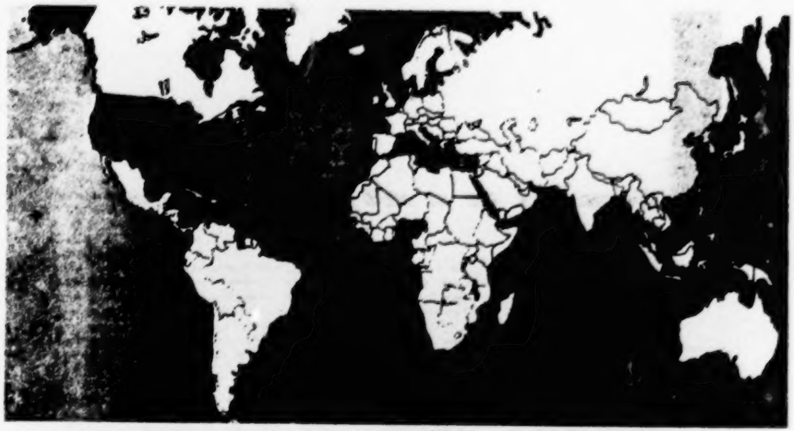
Chase Manhattan Bank, N.A.'s booklet *The Trillion-Dollar Economy*, quotes a study by Professor Edward Denison called *Why Growth Rates Differ* in which he says that if both the U. S. and Northwest Europe had the same amount of resources, the U. S. per capita income would still be 28 percent higher, due to better application of knowledge, a higher quality of management and more intense competitive pressures. This reinforces the general impression that Europe's technological lag is not caused so much by a lack of knowledge as much as by inadequate application of that knowledge. He was speaking of the year 1960. In the past 10 years many European and Japanese companies have been catching up fast—just ask Detroit, or the machine tool builders.

This intense competition from European and Japanese companies should serve to goad U. S. industry to become more competitive through investment in modern facilities as well as ever-improving management techniques.

What if we don't convert?

We won't feel the impact of not converting to metric for some time. After all, our gross national product is about $1 trillion and our export trade volume is some $40 billion per year—about four percent. In the long run, however, as world trade continues to expand, our overall economy will gradually feel it because we will be slowly shut out of our export markets. Eventually we will have to go on a crash program to convert, and at a tremendous expense.

Our exports will gradually taper off because the product standards, which are now being worked on by the ISO (International Organization for Standardization), will be set without our participation. (So far, for the most part, these standards are only recommendations to each of the participating countries. The ISO encourages each country to accept the recommendations as its own national standard.) These product standards will be in metric units, and will result from extensive debate and compromise by the participating nations. These standards could serve as nontariff barriers to exclude American goods.



nonmetric nations shown in black

Meanwhile, although our total economy is not effected, the impact of existing ISO standards can hurt us in individual industries and, of course, geographic regions. The electronic components field is starting to feel the effect even today.

We could head off the problem by taking a much stronger active part in the ISO negotiations, and our voice would be effective because we have so much to offer. Our existing American standards are backed by extensive experience, unequalled in many product lines. (The American National Standards Institute is already involved, but could use much stronger support from U. S. industry.) Our hand would be further strengthened if our negotiators were backed by a U. S. commitment to convert to metric within some well-conceived plan for method and timing.

Only about 20 percent of international standards that we would need now exist. The opportunity for constructive action is knocking at our door. Will we answer it?

Besides product standards, some of the metric units themselves are yet to be standardized. In 1960, the General Conference of Weights and Measures (founded in 1875 by the Treaty of the Meter in Paris) adopted the International System of units (SI) which establishes base units for length, mass, time and temperature, as well as electric current and luminous intensity. Much work needs to be done, however, to both refine present definitions as measurement techniques become more precise, and to phase in other units coherently.

What if we do?

If this country should convert to metric, we would earn the undying gratitude of untold engineering students. Who hasn't suffered through problems of converting force, energy and torque units in pounds, foot-pounds and pound-feet to newtons, joules and newton–meters? And this is not to mention the agonies of school children memorizing inches per foot, feet per mile, square feet per acre and so on. The metric system, with its base 10, would eliminate a lot of unnecessary schoolwork and permit the students to spend more time on thinking out the problem.

But, in a more practical way, metric units would save industry untold hours in design time, permit simpler standardization of modular sizes, reduce errors in engineering, production and accounting, improve the American position in international standards, and create greater acceptance for our exports.

Disadvantages of going metric

Obviously, there are a lot of serious problems connected with converting to the metric system, or we would have done it long ago. As gleaned from the National Bureau of Standards Deerfield Conference described below, some of the problems are:

- Changing hardware, dials, tools, dies, molds and measuring equipment.
- Revising drawings, standards, computations, repair manuals.
- Retraining clerks, inspectors, machine operators, engineers–and top management too.
- Converting computer programs.
- Losing production during transition, with consequent delays and costs.
- Maintaining dual inventories of materials and parts for several years.

Another problem is how to convert. Do you keep the same sizes and just redimension in metric units, or swing over to metric sizes in round numbers?

The first way might seem simpler, and appear to be less expensive, but in the long run it probably would negate the whole idea of conversion. Our products would still be in inches no matter how we labeled them, and they would not conform to international standards. Besides, the benefits of size simplification would not be available.

The only way to convert is to go directly to metric sizes, thereby gaining the full advantages, even at a greater initial cost. At least there would be a payoff after the initial changeover.

National Bureau of Standards Study

The U. S. Congress in 1968 passed the Metric Study Act authorizing an open-minded evaluation of U. S. interests in metrication and charged the Secretary of Commerce with the responsibility. The program was set up under the auspices of the National Bureau of Standards. The NBS has initiated 14 separate

Where They Stood—at Deerfield

Most organizations mentioned here presented comprehensive statements at the NBS Deerfield Conference based primarily on surveys of their members. The following summary of positions cannot possibly do justice to reasoned position papers, and certainly cannot represent differences of opinions among various individuals within each organization. In general, however, our summary represents the position of the group, based on the group's own unique problems within the American industrial complex.

In addition, many individuals were faced with the dilemma of representing a particular group's own interests for the good of that group, as opposed to the individual's personal opinion which might have a broader view of the problem of the U. S. position in today's world.

American Institute of Chemical Engineers—wants metrication now
Manufacturing Chemists Association—sees multimillion dollar conversion cost
American Institute of Mining, Metallurgical, and Petroleum Engineers—supports SI (international metric system)
Society of Plastics Industry—divided opinion, therefore no stand
American Petroleum Institute—sees little need for conversion, but supports orderly transition
Aluminum Association—favors eventual adoption
American Iron & Steel Institute—sees no advantage, but will change to meet customer needs
American Concrete Institute—wants metrication now
Rubber Manufacturers—prefers international system
Copper Development Association—sees long range benefits
American National Standards Institute—takes no stand, but can supply metric information
National Academy of Engineering—takes no stand
American Society for Engineering Education—sees education need
American Society for Testing & Materials—has guide available to aid transition
Can Manufacturers—sees increase in both prices and foreign competition if we convert
Industrial Fasteners Institute—sees billion dollar transition cost (see separate box)
Screw Machine Products—sees high cost, more competition
Screw, Nut & Rivet producers—do not want change
American Society of Mechanical Engineers—sees need for dual capability, will promote SI
Society of Manufacturing Engineers—supports SI, plus a carefully planned conversion
Instrument Society of America—prepared to educate
Scientific Apparatus Makers—sees high conversion costs, unpredictable payout, change inevitable
Consulting and Professional Engineers—no report, but ready to help
American Society of Agricultural Engineers—favors early change
American Society of Heating, Refrigeration, and Air Conditioning Engineers—no stand, but will help
Anti-Friction Bearing Manufacturers Association—sees U. S. position untenable, must change
Farm & Industrial Equipment Institute—favors early start, 15-year transition
National Fluid Power Association—wants change promptly
National Tool, Die & Precision Machinery Association—among first affected, will service customers needs
National Machine Tool Builders Association—takes no stand, but sees inevitability
Association of Home Appliance Manufacturers—takes no position but in general, members want no change
Business Equipment Manufacturers Association—divided opinion, sees problems in conversion, suggests eight-year transition
Electronic Industries Association—sees inevitability, suggests early start, 10-year transition
Institute of Electrical & Electronic Engineers—already uses SI units in publication
National Electrical Manufacturers Association—divided opinion, sees problems ahead either way
Aerospace Industries Association—takes no stand
American Bureau of Shipping—uses dual system now, but is awaiting change to SI by shipbuilders in metric countries
Shipbuilders Council of America—ready to go when customers are
American Railway Car Institute—sees no advantage, but could easily change
Automobile Manufacturers Association—sees no need for metrication, but knowledge of dual system needed
Society of Automotive Engineers—accepts SI with certain exceptions, ready to help transition

studies each asking:

- What is the present impact within the U. S. of increasing world wide use of the metric system?
- What would be the impact in the future—assuming no change in current metric usage and no coordination among various sectors of society?
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Without detailing all 14 studies, in effect they consist of sample surveys of manufacturers both by letter and phone, cost analysis, an evaluation by the Dept. of Defense, and consideration of the effect on various appropriate segments of our society—different levels of government, labor, education, consumers, etc.

One of the studies is a series of seven conferences to give all segments of industry, consumer affairs, education, labor and service fields an opportunity to voice their opinions on the basic issues.

Deerfield Conference

The first conference was held in late August at the Deerfield Academy, Deerfield, Mass. for engineering oriented industry. Invitations were sent to more than 50 trade associations, professional societies, and other groups. About 90 percent responded, most with a prepared position paper. Some guidelines were sent each group to help prepare for the conference. They were asked to respond to these questions:

- What is the present status of measuring system usage; recent and future trends to metric; advantages and disadvantages of metric?
- What are the possible future effects from alternative courses of action: evolutionary (no national program), or planned metrication on a coordinated national program?
- What are your opinions on the need for increased metric usage; any other suggestions for the Metric Study Group to consider?

The conference was divided into 10 sessions, each covering a major segment of engineering oriented industry: petroleum, chemical, and plastics; primary metals, concrete, and rubber; broad national engineering and standards organizations; fabricated metal products including fasteners; mechanical and plant engineering; scientific and process control instruments; consulting and professional engineers; machinery, except electrical; electrical machinery; and transportation equipment.

[illegible]

Positions of participating groups ranged from "let's change now" to firm opposition. By the end of the conference, however, a consensus developed among the participants that going metric is inevitable and that the transition should not be mandatory, but by a voluntary, coordinated national program.

The appliance industry, for example, is opposed to a change. This industry exports few products because of different requirements in foreign homes. They fear that metrication could open domestic markets to imports, reducing their production volume. Another group opposed for generally the same reasons is

How the fasteners people see metrication

IFI position

The official position of the Industrial Fasteners Institute, taken at the NBS Deerfield Conference, was spelled out by Richard B. Belford, Technical Director of IFI, July 21:

"Industrial Fasteners Institute supports the continued use by American industry of USA-developed engineering standards for mechanical fasteners, as based on customary (inch/pound) units of measurements, because (1) fasteners produced in conformance with requirements of USA standards have technical superiority to similar products manufactured in accordance with any of the current systems of engineering standards for mechanical fasteners based on metric modules, and (2) the monetary cost of the U. S. fastener manufacturing industry to convert to the metric system would be exorbitant and with no apparent compensating values.

"At this point, . . . we say: 'however, IFI recognizes that important segments of American industry may elect to convert to metric. In such event, a new system of fastener standards designed for optimum performance capability based on metric modules should be developed.'

"The new system would be a complete 'fresh start' approach not related to any existing system. The purpose would be to achieve optimum performance capability in all materials used in the fastening function and to attain maximum simplification in the number and styles of standard fasteners. . . .

"Further, IFI believes in freedom of choice, and would not support any action to make mandatory the use by American industry of either system of fastener standards."

Mr. Arthur R. Breed, Technical Director of The Lamson & Sessions Company added a few remarks: ". . . a task force composed of the engineers from the member companies of IFI was established through the Standards and Technical Practices Committee . . . to determine whether there can be change for value if we increase the use of the metric measurement system. The task force has first of all to investigate where we stand now. Those of us who have 'multi-dimensional' experience know the strengths and weaknesses of both measurement systems, and in particular the standards that have been based upon them. We know the strengths and weaknesses of the application of material to those standards."

"After the task force investigates where we stand now in both inch and metric and in available standards and specifications, we propose to develop . . . a brand new approach toward modules of size. This will include nominal sizing of threads, the entire basis for possible expansion. The possible expansion includes what materials . . . how they can be used—to their fullest advantage, for example, head styles of fasteners now available in inch and metric . . . ."

Beloit Tool position

The Beloit Tool Corporation, Beloit, Wisconsin, a leading manufacturer of cutting tools and gages has another idea. In a recently published booklet called "U. S. A. Goes Metric", they quote Fred C. Ewert of John Deere & Company to sum up the problem. "America has only two choices in the role it can play in world standards: to assume an active role of leadership or to wait for others to develop standards that we eventually must use."

Mr. Kenyon Y. Taylor, President of Beloit answers:

"The ISO-SI (International Organization for Standardization) has developed very workable standards in most areas; however, in fasteners and screw threads, the ISO proposed standard is incomplete and produces assemblies unsatisfactory to U. S. industry.

"Although there are few things in greater need of standardization than screw threads and the nuts, bolts and screws used to fasten practically every known mechanical device in industry, the ISO Standards Committee set up in 1946, formally abandoned their attempts to develop one standard system in 1957. It was then agreed that two systems would be accepted by ISO, the Unified-Inch already fully developed by America, Britain and Canada and a new SI metric standard system. The new ISO metric system, fortunately, has many points in common with our Unified-Inch system, both being made to the same thread form.

"The Beloit method of screw thread metrification consists of weaving ISO and present unified American threads into a metrified table and conversion of all present tolerances covering tools, gages and product fits into metric language.

"Although metrication of screw threads and fasteners will require many years to complete, we will live in a metric society where the terms 'inch' and 'decimal inch' will have no meaning. Dual designation will help during the transition but we must have a method here at Beloit to properly identify the standard thread series presently in use and to intelligently assist and guide our customers into the correct future standard.

"The proposed Beloit method of thread designation has the advantage of 'dual designation' plus a continual guide toward a new, true international standard. We believe the eventual standard will not be established by a technical committee edict but by industry experience as to the advantages of each particular item in the combined ISO-Unified Thread Series. Hopefully, by industry usage, these two series will become part of a single new International Standard Screw Thread System."

The *U. S. A. Goes Metric* booklet contains articles on the history and explanation of the metric system, an explanation of dual dimensioning, how present toolholders can be used, and an explanation of Beloit's new combined ISO-Unified Thread Series with appropriate tables showing how the new metric identification system works. Copies may be obtained from [illegible] Publishing Company, Box [illegible], [illegible], Ill. [illegible], [illegible] for a single copy.

the fastener group (see the box above for their official position).

On the other hand, the American Concrete Institute, among others, wants to change now. The increase in precast construction is leading to two sets of standards, one here and one overseas. The box, on the facing page, shows how each group responded.

All in all, the first conference was well planned, well run, and provided a wealth of information on how the various engineering-oriented industries see the problem of metrication.

This report is the first of a planned series of articles which will cover the subsequent conferences: consumer related industry, construction and related groups, consumer affairs, education, labor, and general including agriculture, mining, transportation, utilities, banking and service industries. Subsequent to the conference reports, we plan to publish a report on where Britain stands today, halfway through a 10-year transition program. Early reports indicate that Britain is making a much faster and easier conversion than anyone expected—and they have the additional problem of converting their currency. ▲▲

article 2

The whole world is going metric—part II

The U.S. is the only industrialized nation in the world not committed to the metric system. With this fact as a backdrop, here's a report on the National Bureau of Standards Metric Conference on Education. Although they are anxious to convert to metric and could move rapidly, many educators, pushed for a carefully coordinated national program with a 10-year transition.

Frank Hall
senior editor

Unencumbered by major capital investment, threat of foreign competition, or the necessity of making a profit, the educational experts are enthusiastic about the U.S. converting to the metric system. On one hand, their attitude might be termed "unrealistic" by those in industry who have the above responsibilities. But on the other hand, they do deal with people, in many cases our own children, and we should listen to what they have to contribute to the overall question of metrication.

At the NBS Metric Conference on Education, 33 specialists, in formal presentations covering all phases of education, agreed that converting to metric would be good for education, provided the transition were government sponsored and well planned with fixed dates. Costs to education would be minor because most investment affected would be in textbooks, which are revised every five years anyway.

The questions

In extending the invitation to the conference, the NBS asked the educators:

- Where is metric being taught today; where should it be taught if a national program is adopted?
- What problems will be faced; what will conversion cost for in-service teacher training, books, equipment?
- What are the advantages of the metric system in education?
- If adopted how should conversion in education be planned; how long will it take; what can be done to help "think metric"?

The response

According to the NEA (National Education Association), speaking for more than one million members, educators favor the metric system for all age groups. It saves time and is easier to understand. But, it is only effective when it can be related to life outside the school. They support a 10-year, nationwide conversion program with a short two or three-year planning program for in-service teacher training prior to the nationwide start.

All contributors to the conference agreed that a purely voluntary approach to conversion would not work. This is what we have now, and the strong motivation of the educators for early, planned conversion stems from their dissatisfaction with the present setup. The complex English system with its fractions, and assorted unrelated equivalents is difficult and time consuming to teach. With two kinds of pounds, dry and liquid quarts, eight kinds of tons, 56 kinds of bushels and specialized units such as cords, board-feet, rods, fathoms, furlongs, stadia, and picas and points, who can claim he has mastered it all?

A number of science courses introduced within the past several years use the metric system exclusively. Three, developed with funding from the National Science Foundation, are laboratory oriented with apparatus included. Another, the Intermediate Science Curriculum Study (ISCS) is an individualized instruction program for grades 7 through 9. The course uses only metric for measurement of distance, force, mass, volume, weight, temperature and energy. The students progress according to ability and interest and although the use of metric is only secondary to the subject matter, they soon learn to think metric. The course includes tests, laboratory apparatus, self-assessment, teacher orientation and standardized tests. After special training, the teachers spend less than five percent of their time with the class as a whole, which comes as a shock to some, but results show that the course is effective for all ability levels and a broad range of school situations, and that reading level is relatively unimportant. The significance is that here is a way to teach science to children who may be from widely diverse backgrounds, that can go as far as their abilities and interests permit, and that the so-called culturally deprived child has a chance to succeed at something, possibly for the first time in his school career.

Other courses for elementary and high schools using metric are available from the Physical Science Group at MIT Educational Development Center, Elementary Science Curriculum from AAAS, and Qualitative Physical Science from Duke U.

College level courses such as chemistry, physics and biology have used metric units for years.

Geology courses use metric only where needed, but as the trend increases, so do problems with dual systems. Engineering educators foresee substantial problems. The physics and chemical engineering teachers welcome change, but those in design and engineering application pointed out that since the calorie, Btu, horsepower, dyne, maxwell and erg will disappear, reference tables, charts and diagrams, such as steam tables and Mollier diagrams will all have to be revised. Laboratory equipment must be converted, and this will necessitate dual systems for some years.

Changeover for engineering students could begin at the freshmen level and would need four to five years to complete, with revision of textbooks and reference materials during this time.

Vocational educators from ten divisions of the American Vocational Association agree that a planned program is necessary and many of them suggested plans for scheduling the transition. Except for courses using machine tools, conversion can be completed in two to five years with minor cost. Trade schools need five to ten years to hold equipment costs to a minimum.

Since vocational schools train students for a particular occupation, training in the metric system would have to tie in with employer conversion. The vocational educators are also extensively involved with adult education and are prepared to offer courses for using metric on the job as well as courses for consumers. The Manpower Development Training division recommends programmed instruction for the adult to learn exactly what he needs without wasting time.

Advantages to teaching metric

Both the NEA, representing elementary and secondary education, and the AVA representing vocational school educators agree that teaching metric has a number of advantages:

- Metric, with its base 10, is easy to understand, remember and use.
- Calculations are more accurate when dealing in decimals instead of fractions and can be made on a slide rule.
- Since work-a-day units are related, the system is easy to comprehend. (The circle, however, still has an irrational relationship between diameter and perimeter. π cannot be abolished.)
- Measurements are simpler and more accurate with decimal graduations.
- Similarity between our coinage and the metric system helps learning.

From industry's point of view, when a new generation of metric-trained workers joins the work force, untold hours of design time will be saved, as well as a big reduction of errors in engineering, production and accounting.

One of the big problems right now in education is that in many cases dual systems must be taught. One contributor made the point that continued delay in adoption of metric while the rest of the world converts, makes it necessary for each student to master both, while many adults find it hard to master one. ▲▲

National Bureau of Standards Study

The U.S. Congress in 1968 passed the Metric Study Act authorizing an open-minded evaluation of U.S. interests in metrication and charged the Secretary of Commerce with the responsibility. The program was set up under the auspices of the National Bureau of Standards. The NBS has initiated 14 separate studies each asking:

- What is the present impact within the U.S. of increasing world wide use of the metric system?
- What would be the impact in the future—assuming no change in current metric usage and no coordination among various sectors of society?
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Without detailing all 14 studies, in effect they consist of sample surveys of manufacturers both by letter and phone, cost analysis, an evaluation by the Dept. of Defense, and consideration of the effect on various appropriate segments of our society—different levels of government, labor, education, consumers, etc.

One of the studies is a series of seven conferences to give all segments of industry, consumer affairs, education, labor and service fields an opportunity to voice their opinions on the basic issues. Last month we reported on the first conference which was for engineering-oriented industry. This article reports on the National Metric Study Conference on Education, held in Washington D.C. October 14-15, 1970.

Where the Educators stand at the NBS Conference

Just as at the engineering-oriented Deerfield Conference, most of the 33 spokesmen at the Educational Conference presented comprehensive statements representing their respective groups. And again, our summary cannot possibly do justice to reasoned position papers and certainly cannot represent differences of opinions among various individuals within each organization. In general, however, our summary represents the position of each group.

College level

College education groups agree that the U.S. should convert to metric. The chemists (ACS), physicists (AIP and AAPT) and biologists (AIBS) already use metric and complain of the necessity of students needing the dual systems. The engineering educators have mixed feelings, saying that as a plus, metric will bring all engineering branches closer together, but also say that it will require a new basis for judgment. The mathematicians (MAA) would welcome the change, could accomplish it overnight, but prefer to remain as observers. The geologists (AGI) use little metric now, but since dual systems are a big problem, say that the advantages of a national program to convert would far outweigh the disadvantages. The American Library Association stands ready to help, takes no stand.

Elementary and secondary level

Representing more than one million members, in some 11 divisions by specialty, the NEA (National Education Association) position recommends an official program with a two-year preparation and 10-year transition period. The school principals (NASSP) say 80 percent of students now receive some metric training which takes 40 percent less time to teach. Problems will be in reaching adults and older teachers.

Vocational level

Various phases of vocational education were represented including technical education, trade and industrial, industrial arts, agriculture, business, health, guidance, home economics and distributive (work-study) education. All agree on the advantages of metric, many suggest a 10-year transition, and several suggested training programs. They made the point, however, that since vocational courses prepare students for work, training in metric would be of little help until industry converts.

The whole world is going metric—Part III

According to Dr. Lewis M. Branscomb, Director of the National Bureau of Standards, "the old standby 'A pint's a pound the whole world round' must soon be changed to 'A pint's a pound from Long Island to Puget Sound.' The world of nonmetric measures is shrinking fast."

Frank Hall
senior editor

The interesting thing about the National Bureau of Standards Conferences on Metrication is that groups representing a broad cross section of American society, meeting independently, came up with the same conclusions: Conversion to the metric system in the U. S. is inevitable, and that what is needed is a well-planned, coordinated national program over a period of years.

Speaking at the Conference on Consumer Affairs, Dr. Lewis M. Branscomb, Director of the NBS put the evolution of the use of metric into perspective. He said that in 1866 Congress made metric units legal in the U. S., and in 1875 we signed the Treaty of the Meter that established metric units as official international units of measure. Since that time 43 nations have joined, and the International System of Units (SI), an internationally harmonized system of compatible, scientific measurement units has been adopted. The inch was established at exactly 25.4 millimeters. In fact, the primary measurement standards maintained for the United States by the NBS are all SI (metric standards).

Dr. Branscomb pointed out that only the U. S. and Canada among industrial nations are persevering with pints and pounds, and even Canada "has declared eventual conversion to metric a definite objective of official policy."

According to Dr. Branscomb: "The arguments for changing to metric usage concern the possible impact on foreign trade, the ability to communicate effectively throughout the world, and the intrinsic simplicity and logic of the metric system itself. The growing interdependence of nations, as we share one another's products, vacationlands, and pollution, suggests that harmonizing our measurement language with that of the rest of the world may be a desirable, and perhaps even a necessary step. . . . But misunderstanding of what a change to metric measurement means is so widespread, and both advantages and difficulties are so poorly understood, that an objective study of the situation is essential. We must try to evaluate the value to the U. S. of harmonizing our measurement practices with the rest of the world—and estimate the difficulty of doing so, and the consequences of continuing to be different. We must try to separate facts from myths and examine alternatives for the nation."

Consequences of being different

In discussing the "consequences of being different," Dr. Branscomb mentioned that both the ISO (International Organization for Standardization) and the IEC (International Electro-Technical Commission) have decided that after January 1974 all international standards will be written in SI units.

"Perhaps more significant than the growth of standards writing activity," Dr. Branscomb said, "is the development of new means for standards enforcement that may make . . . compliance involuntary, at least in certain markets. Thus the Economic Commission for Europe, (ECE) in February 1970, endorsed a recommendation that standards used in international trade should be harmonized on the basis of ISO and IEC recommendations. The ECE also endorsed, in principal, the proposal that quality assurance and product certification programs in international trade be based on ISO and IEC standards. The most specific certification system being established is in the field of electronic components, to be administered by the Committee for Coordination of European Standards in the Electrical Field (CENEL). Systems of this kind emphasize the increasing importance with which many nations view nontariff means for regulating trade. Industrial standards can be generated and enforced in such a way either to facilitate trade within a group of cooperative nations or to erect a barrier against imports of nonconforming products.

"The extent to which hardware changes must be made is in part a question of the consequences of harmonizing our national product standards with those of metric nations, and partly a question of presenting the American consumer with products whose quantity is described in a single measurement system. With regard to standards, the impact on U. S. industrial practice will depend substantially on the vigor with which the U. S. participates in international standards negotiations, for it is a matter of give and take.

"Many hardware items come in standard sizes all over the world, originally designed in inches in the U.S.A., but described abroad in millimeters by people who have no need to be aware that the original design engineer was working in inches. Automobile wheel marks [tire sizes] are an example. Dimensional specifications for many other products could, in principle, become officially metric by their being adopted as international standards under procedures of the ISO. Whether this happens depends in part on the vigor with which U. S. industry pursues international standardization, the extent to which consumer groups can encourage and participate in this activity, and the encouragement and support that can be forthcoming from the Federal Government. In any case the opportunity is here, for the past 10 years' experience suggests that during the next 10 years a substantial fraction of the national standards of industrialized nations, especially in Europe, will be processed through the ISO and its affiliate the IEC."

Consumer-oriented Industry Conference

Held in the Department of Commerce auditorium, Washington, D. C., during the week of Sept. 21-27, the NBS Metric Study Conference on Consumer-oriented Industry heard 38 organizations present their views on metrication in the U. S. In general, the opinions were similar to those expressed at the earlier Engineering-oriented conference at Deerfield, Mass. Some industries openly opposed U. S. conversion to metric, a majority were for conversion, and almost all felt that it is inevitable.

The formal presentations responded to questions sent earlier by the NBS:

- What is the present and future impact on your industry of the increasing worldwide use of the metric system?
- What would be the effect of a national program to increase the use of the metric system; how should it be done; how long will it take; what will it cost; what will be the major problems in your industry?

Of the 32 organizations responding, eight wanted to change right now and four were opposed to any change. The majority of the remaining groups were in favor of change, but some stressed the need for sufficient time for conversion and others gave it reluctant support because they felt conversion in the U. S. is inevitable. About 10 groups took no stand at all, either because the group was still studying the question or because no consensus could be reached within the group.

Problems

Little information was presented on cost of conversion, but some of the problems foreseen were as follows:

- Conversion of machinery or equipment would be a major cost problem according to the paper makers, printing industries, and canners.
- Dual inventories needed during transition years would be a cost problem to wholesalers, soft-drink bottlers, and auto dealer service departments.
- Training of personnel was a major problem discussed in more than half of the presentations.
- Educating consumers was mentioned as a major problem by almost all groups. (See Part II of this series, Jan. 1971, page 44 for the educators response to this problem.)

Advantages

Aside from the obvious advantages of the ease of handling decimal units with resulting reduction of errors and time savings discussed in detail in our two previous conference reports many of the consumer-oriented associations see major benefits from the opportunity to simplify package and size standards if conversion to metric were to proceed on a nationally coordinated time table.

The food chains, soft-drink bottlers, refrigerated warehousemen, newspaper publishers, and shoe manufacturers could all benefit from simplification. The apparel industry sees an advantage in metric standards for women's clothing because of the present confusion in size designation, but for men's clothing, the industry foresees that more sizes will be required to cover the same range now available. For example: metric standards for shirt collars require 11 one-centimeter steps to replace the present size steps in 1/2-inch increments.

For a summary of how each group responded, see the box on opposite page.

The National Bureau of Standards Study

This is our third report on the NBS Metrication Conferences that took place last fall. The first article covering engineering-oriented industry (Dec '70, p 38) reported that whereas opinions varied from "now" to "never," a strong majority regarded U. S. conversion to the metric system as inevitable. The second article covering education (Jan '71, p 44) reported that most professional educators, while anxious to teach only metric in the schools, suggested a carefully planned and coordinated national program with a 10-year transition period to ease conversion.

Congress in 1968 passed the Metric Study Act authorizing an open-minded evaluation of U. S. interests in metrication and charged the Secretary of Commerce with the responsibility. The program was set up under the auspices of the National Bureau of Standards. The NBS has initiated 14 separate studies each asking:

- What is the present impact within the U. S. of increasing world-wide use of the metric system?
- What would be the impact in the future—assuming no change in current metric usage and no coordination among sectors of society?
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Without detailing all 14 studies, in effect they consist of sample surveys of manufacturers both by letter and phone, cost analyses, an evaluation by the Dept. of Defense, and consideration of the effect on various appropriate segments of our society—different levels of government, labor, education, consumers, etc.

One of the studies is a series of seven conferences to give all segments of industry, consumer affairs, education, labor and service fields an opportunity to voice their opinions on the basic issues.

This article reports on the conference on Consumer Oriented Industry, Consumer Affairs, and Labor.

Where consumer-oriented industry stood at the NBS conference

Most of the 32 spokesmen at the Consumer-oriented Metric Study Conference presented formal statements representing their groups. As with the engineering-oriented and the educational conferences, we cannot do justice to carefully prepared position papers, and cannot represent differences of opinions within each organization. In general, however, this summary represents the position of each group, based on its own unique problems within the US industrial complex.

Food Technologists urge early adoption, see few technical problems but traumatic change for industry.

Wholesalers believe metrication inevitable and worthwhile, but consider increased inventory costs prohibitive without some relief.

Food Chains see little advantage, but can change. Suggest 10-year transition.

Refrigerated Warehousemen concerned with changes in package sizes, see benefits in size simplification.

Retailers see inevitability of conversion, need for mass education, increased costs during transition.

Soft-drink Bottlers strongly opposed to change because of investment in billions of "floating" returnable bottles.

Frozen Food Industry opposed to change in package sizes, has no interest in metric.

Meat Institute concerned about challenge to consumers. Major costs will be for new weighing and packaging equipment. Nutritional data is already in metric.

Canning Industry sees little reason to change, uses metric in labs, dual labeling for export. Cost could be minimized if only can height is changed. Planned program needs 10-15 years; industry would need financial aid.

Evaporated Milk Field not ready with decision on conversion, but foresees no problem with a coordinated 5-10 year conversion period.

Salt Industry sees no need to change. Since American standards are better than metric, rest of world may have to convert to ours.

Scale Manufacturers favor metrication for increased exports. Metric divisions better than fractional, but converting millions of scales, including postal, will be expensive, take 10 years.

Textile Manufacturers look forward to change, for new simplified size standards in metric and to increase exports.

Apparel Industry split between those who say: "Why change" to those who say: "Conversion is long overdue."

Footwear Manufacturers feel advantages of metric would outweigh cost of conversion. Imports now 35 percent. Mechanization and simplification could increase worker productivity, decrease export of jobs.

Merchandise Vending Field can convert in 3-5 years, want change to expand exports.

Toy Manufacturers ready now, the sooner the better. Use of foreign suppliers has led to dual dimensioning.

Appliance Dealers see cost problems in servicing, want consumers educated first. Could convert in two years, but main burden would be on manufacturers.

Printing Industries plan a study of metric impact. Change would be costly, but they could live with it.

Publishers will set up study committee, see conversion inevitable, suggest we learn from British experience.

Book Manufacturers want no change, see no advantages.

Newspaper Publishers see changeover to electronic typesetting as good opportunity to convert to metric now.

Paper Makers will go along, but not push; see long-term advantages but high cost; need orderly change, relief.

Theatre Equipment Builders of projection and sound equipment want no change, although they see advantages for country as a whole.

Motion Picture Producers favor early change, have large export trade. "The longer we wait, the harder the change."

Motion Picture Engineers prefer metric, have long used dual systems and been involved in international standards.

Automobile Dealers (service departments) see little need for change. Conversion to metric will require training of 800,000 mechanics and dual inventories for at least 10 years. However, imported cars (mostly metric) now 11 percent of total.

Independent Garage Owners see inevitability, favor gradual conversion. Auto makers will determine change.

Import-export Commerce favors metrication; wants change soon to reduce errors in cable transmission, eliminate dual systems.

Quality Control Engineers claim metrication is coming, ask how much longer will we delay. Conversion will be routine, requiring only routine updating of standards.

Major Museums ready to help educate public to advantages of metric through exhibits to large adult audiences.

Collegiate Athletics favor planned conversion because metric would help U. S. athletes in international competition. Suggest leaving football in customary units.

Consumer Affairs Conference

The NBS Metric Study Conference on Consumer Affairs, held October 13 and 14 at the NBS, Gaithersburg, Md., discussed the impact of metrication on clothing, food, home, automobile use, and advertising.

Some general presentations were made by Dr. Branscomb, cited earlier, and by Virginia H. Knauer, special assistant to President for Consumer Affairs, Mercedes Bates, president of the American Home Economics Association, J. D. Buchanan, former statistical advisor to the British Consumer Council and Faith Pryor, University of Vermont.

Almost all of the 23 participants making formal presentations stated that the advantages of conversion outweigh the disadvantages, especially since conversion to metric presents an opportunity to eliminate the confusion that now exists in size standards. All agreed, however, that conversion would require a massive adult education program.

Every survey taken in preparation for the conference indicates consumer indifference, apathy and apprehension. Consumers in general are not familiar with the metric system and are not aware of any contemplated change. The small minority who have had previous contact with the metric system, through military service, business relocation, or travel are eager for the change and reported that metric is easy to learn and helpful in making price comparisons.

Most participants in the conference stated that the major problems of conversion would occur during the transition period and cited these advantages following conversion:

- Metric's decimal base simplifies unit price comparisons
- Metric is easier to teach in school
- Cooking calculations are simpler
- Increased exports and imports could lead to lower prices
- Clothing sizing can be simplified
- Confusion over dry and liquid measures (pints, quarts) would be ended
- Metric base in clothing industry could lead to mechanization, computer control and lower prices

According to J. D. Buchanan, now with the Canadian Department of Consumer Affairs, some consumer problems in Great Britain involve beer and milk. When a man enters a pub and orders a pint of beer, he gets about 600 milliliters. But the standard metric size is 500 milliliters (1/2 liter), and of course producers and pub owners fear that the reduction of volume will hurt business. Returnable glass milk bottles are used universally. The changeover to metric might not only reduce the volume of milk sold, but will require dual bottle sizes until the older ones are phased out through normal breakage. Incidentally, we in the U. S. won't have quite the same problem because our liquid measures are smaller than the British imperial pints, quarts and gallons by 20 percent, and therefore closer to multiples of liters.

R. L. Smith, assistant director of Consumers Union agreed that metrication is inevitable, advantages outweigh disadvantages, and that some useful byproducts may follow from simplification. He said, however, that government incentives will be needed, costs are generally exaggerated, and that consumer apathy will be hard to move although the climate is more receptive now than in the past. Assistance by the Advertising Council, Consumer Federations and women's magazines will be needed.

Theodore Dunn, Research Director, Benton and Bowles, and chairman of the American Association of Advertising Agencies metrication study committee said that the AAAA is ready to aid in educating and motivating consumers using donated time on television, over the radio, and in print.

Labor Conference

The NBS Metric Conference on Labor was held October 27 in Gaithersburg, Maryland.

With the cooperation of the AFL-CIO, related industry unions were grouped and a spokesman for each group was selected and asked to respond to the following questions:

- Any past experience with metric?
- What advantages and disadvantages do the workers see in metrication, assuming a 10-year transition period?
- How much training will be needed; who will be trained, and how?

Response

In general, the response indicated a great lack of interest. Seven of the 10 groups sent questionnaires to the unions in their group. Of the 132 unions included, only 40 responded.

According to Nathaniel Goldfinger, Director of Research AFL-CIO, the official position of the AFL-CIO is friendly neutrality. It takes no stand, for or against, but recognizes that some important human issues would come up in any conversion to metric:

1. Protecting workers' investments in tools that would become obsolete.
2. Knowledge of the metric system may become a prerequisite to a job.
3. Training of the workers.
4. Relief measures to offset costs of metrication to individual workers.

Mr. Goldfinger went on to state that transition will require a stable economic environment and plenty of time for human adjustment. There should be no bars to hinder upgrading, and older workers must not be blocked off from new opportunities.

Many presentations questioned the need to consider metrication. Some unions were unaware of any contemplated change, and others felt the possibility of a change was remote. All were concerned that where workers owned tools, they should not be burdened with the expense of new tools, and all called for the employer to pay for needed retraining, including travel time. They agreed that the major headaches would occur during transition, and that once transition is completed, no long range problems were expected. Some saw positive benefits: a simpler system with less chance of error and easier to understand, more export opportunities and benefits to workers as consumers.

Open opposition came from some construction unions such as the plasterers, carpenters and electricians. The brewery workers were most adamant. After presenting the materials sent to him on the metric study to his executive board by Anthony C. Weinlein, Executive Assistant to the General President, Service Employees Union, Mr. Karl F. Feller, President of the Brewery Workers replied:

"Their disposition was . . . that we would not participate in any conference or further study of the metric system and to notify you as well as Mr. George Meany, president of the AFL-CIO that we are opposed to giving any consideration to change. Our reasons are obvious—the cost of changeover in tools, machine tools, containers of all sizes in liquid and solid systems, etc. is prohibitive . . . We will not participate nor will we support the study."

Where they stood

Service employees (except the brewers) say change is desirable because metric is logical, easy to understand and remember. Retraining must be at employers expense.

Oil and chemical workers say metrication is necessary, change is overdue. Cost should not be placed on workers.

United Mine Workers say change is desirable and inevitable, coal future is in technology, export market gaining importance. Massive public education program is needed.

Textile and garment workers unaware change is contemplated, express disbelief, but see no great problems and some advantages. Workers should not pay for new tools.

Construction workers (Building Trades Dept.) take no official stand, but plasterers foresee calamity, carpenters foresee chaos, and electricians see large tool and retraining costs.

Transportation unions see little advantages, but want metric tools paid for by employers, retraining on paid time, no disruption in seniority systems.

Airline pilots feel metrication is good but retraining pilots used on domestic flights will be a handicap.

Arts-engineering, printing trades have little metric experience, are concerned about costs of tooling and retraining. Many older employers cautious or opposed, but education and training can overcome fear and resistance.

Machinists who own their tools, are concerned about costs of metric tools. Some unions vehemently opposed to change, others recommend go-slow approach with educational program first.

Glass, ceramic and others. Foundry workers see current worldwide trend, want speedy conversion. Communication workers see loss of productivity and more errors during transition. Furniture workers stress need for education. Glass bottle blowers see metrication increasing exports and jobs. Glass workers concerned about cost of tools. Leather goods workers foresee education problems among unskilled workers. ▲▲

Machinery

METRIC CONVERSION TABLES ARE DESIGNED AS A PULL-OUT BOOKLET. TO SEPARATE THIS BOOKLET, GRASP THE METRIC CONVERSION TABLE SECTION, PAGES 13 THRU 36, AND PULL OUT. THEN STAPLE THE CONVERSION TABLE PAGES TOGETHER.

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article 4

The whole world is going metric—part IV

Metrication can be a challenge to manufacturing and engineering to completely reassess operations. Benefits from resultant innovations and efficiencies can far outweigh any conversion costs. Besides, conversion costs are temporary, but benefits go on and on.

Frank Hall
senior editor

Is the design of our product right? Are new standards required? Is the product being made in the best way? Are we using our equipment the most efficiently? Is our sales effort right? Is the supporting literature good enough? Can the product be sold in new markets? These questions should be asked all the time, or at least periodically. But are they?

According to Gordon Bowen, Director of the United Kingdom Metrication Board, probably the greatest benefits of converting to metric are "the fundamental changes deriving from such a critical re-examination, triggered off by the change to metric which may in some instances lead to large capital expenditures—but these costs are the costs of innovation. Metrication itself can account for but a fraction (of the total costs) . . . (and they are) not identifiable in the wave of innovation which the metric change may have occasioned."

Mr. Bowen was speaking at the final conference on metrication held by the National Bureau of Standards, and was sharing some of the experience gained by the British as they reached the halfway mark in their planned 10-year transition to the metric system. He said, "I am very conscious of the great volume of work and discussion which has gone on within the U.S. since the (Metrication) Study was authorized by Congress in August 1968. I am aware too, that circumstances, in the U.S. and in the U.K. are in many ways very different and it would be dangerous to draw too close parallels . . . It will be for you to judge the relevance to your circumstances and needs."

Mr. Bowen pointed out that the greatest changes occur in the manufacturing and, especially the engineering industries—but, that is also where the greatest benefits can be achieved, providing the opportunity for complete reassessment mentioned above is embraced.

Cost of Conversion?

"One of our great . . . problems," Mr. Bowen said, "is our inability to answer the question, how much will all this cost? . . . We have found it unanswerable . . . If it were merely a matter of changing measuring tools or altering weighing machines, it would be possible, but by no means easy, to make some reasonable approximation to a probable aggregate cost figure. But . . . the metric change is associated with a host of other changes. The extent and timing of these changes will be determined by literally thousands of decision-making centers and individuals . . . I am talking about decisions which in many cases have yet to be taken and implemented. (For example):

- "Is the weighing machine to be replaced because of the metric change or because it no longer fits the needs of a shop that has gone over to self-service and incidentally to metric?
- "Is the machine tool to be replaced because of metrication or because there is need for a better, faster, more automated capability to make the new model which is also designed in metric?
- "Are the new metric school books purchased because the existing ones are worn, old fashioned and obsolete or simply inadequate?

"These are some of the problems of assessing the costs of individual decisions. It is even more difficult to attribute the costs within an individual corporation. Many of our firms with sophisticated accounting techniques have reached the conclusion that trying to identify the metric element is not truly meaningful and certainly not worth the accounting effort required even to achieve an approximation. Some costs can, of course, be identified, such as replacing road signs, but looking over the whole range of changes associated with metrication, this is very exceptional. There are metrication costs but they are inextricably mixed with the costs of larger innovations and reforms.

Assessing benefits

"It is equally true that the benefits strictly attributable to the metric change are likewise difficult to isolate, identify and quantify. They are there but buried in a host of other gains flowing from a series of sound management decisions. There are some benefits which are at least in part quantifiable, such as the economy achieved in not burdening our education system with teaching two systems of measurement and concentrating the effort on the simpler and more generally useful one. But even there it is not possible to quantify the benefits in terms of a better educated generation of students, yet this could be the most important single gain of all.

"We shall be extremely interested to see the results of your efforts to quantify the costs and benefits of the metric change. We in Britain for our part have based our policy and decision on the unquantified conviction that the costs of not changing could be very high and that the gains from metrication will far outweigh the costs, not least because the costs are once and for all and the gains are continuing and cumulative. The full benefits will not be attained until we are substantially a metric society living in a metric world. This is not, in our view, a distant vision but a foreseeable reality."

Mr. Bowen added a word of caution: "It will not all be plain sailing. Some changes will be more difficult or less acceptable than others. Some will involve costs and not very evident or perhaps only distant and contingent benefits. We all like familiar habits and ways. There is a good deal of inertia built into us as individuals and into our free society, which may perhaps be one of the stabilizers.

"We must accept that there will be laggards and there will be those who decide not to change. Whether they are wise or foolish we can leave the event to decide. We must not, however, allow them to determine the general pace. One of the truths which our experience to date has demonstrated is that while there must be adequate time for planning and preparation, *once a program is decided upon, putting change off and spreading it out does not ease the problems to be resolved, can add to the difficulties and costs, and inevitably it defers the benefits.*"

Industrial interdependence

Emphasizing the importance of careful planning and coordination, Mr. Bowen pointed out that no one firm, even a monopolistic one, can go metric on its own. There's nothing like a metrication program to bring out how interdependent our industrial society really is.

"A program, or even a target date for the converted change," he said, "is a great help to a producer and to his customers. It alerts materials suppliers and component manufacturers so that they can respond. It puts customers on notice so that they can

The National Bureau of Standards Study

This is our fourth report on the NBS Metrication Conferences held last fall. The preceding articles covered the conferences on engineering-oriented industry (Dec. '70, p. 38); education (Jan. '71, p. 44); and consumer-oriented industry, consumer affairs, and labor (Feb. '71, p. 48). Although the opinions expressed at each of the conferences varied from convert "now" to "never," a common thread running through all of them held that U. S. conversion to metric is inevitable, and that a carefully planned, well-coordinated 10-year transition period is necessary to ease conversion. Congress in 1968 passed the Metric Study Act authorizing an open-minded evaluation of U. S. interests in metrication and charged the Secretary of Commerce with the responsibility of carrying it out. The program was set up under the auspices of the National Bureau of Standards. The NBS has initiated 14 separate studies each asking:

- **What is the present impact within the U. S. of increasing world-wide use of the metric system?**
- **What would be the impact in the future—assuming no change in current metric usage and no coordination among sectors of society?**
- **What would be the effect of a coordinated national program to increase use of the metric system?**

Without detailing all 14 studies, we can say that they consist of sample surveys of manufacturers both by letter and phone, cost analyses, an evaluation by the Dept. of Defense, and consideration of the effect on various appropriate segments of our society—different levels of government, labor, education, consumers, etc.

One of the studies is a series of seven conferences to give all segments of industry, consumer affairs, education, labor and service fields an opportunity to voice their opinions on the basic issues.

This article reports on the conference on the Construction Industry and the final, service-oriented groups general conference.

Where the construction industry stood

The "organized" construction industry including its professional societies made 21 presentations to the [illegible] Study Conference. As with the [illegible] we cannot possibly do justice to [illegible] position papers, and certainly [illegible] differences of opinion within each organization. In general, however, this summary represents the position of each group, based on its own view of its own unique position within the U. S. industrial complex.

Architects urge early adoption of metric for the [illegible] construction industry on a 10-year program [illegible] by the government, foresee conversion of [illegible] data and building codes as major problems.

Building [illegible], publishers of model codes, [illegible] say metric will aid exchange [illegible]

Building officials, [illegible] codes, [illegible] to accept it. Once started, conversion will take at least three years, should be done as fast as possible.

Brick industry sees no need to change, but expects it, favors 10-year planned program. Metrication could simplify number of sizes; equipment can be converted during normal maintenance, but major problem is "unlearning the old."

Concrete block producers claim metrication will be disastrous, transition frightening, but see change as inevitable.

Concrete Institute, standards-writing technical society, favors change, says precast industry could adopt metric now to save later. World-wide agreement on notations nearly ready for adoption.

Consulting Engineers Council defers to member societies on position, says transition costs will run five percent.

Civil Engineers Society, surveyed 14 divisions, concluded metrication is advisable, and gave detailed report on how to convert promptly. Will start now to use dual systems in all publications, suggest land title conversions at time of transfer.

Electrical contractors [illegible] to convert as soon as possible, say metrication is desirable and inevitable,

make their preparations for absorbing the change.

"This is well illustrated by the progress of metrication in the U.K. construction industry. A program there stimulated manufacturers of building materials and components, it aroused architects and through them their clients. It caused manufacturers of fitted furniture and other built-in elements to consider their designs in metric terms.

"One sector cannot be indifferent or even ignorant of what other sectors are doing. It needs them to move in concert with its program. On the other hand, if everyone waits for everyone else then nothing happens. Someone has to take a lead. And as this involves taking calculated risks—there is need to give encouragement. We in Britain have not done this by financial inducement or recompense but by encouraging those with the necessary initiative. Government Departments have been ready to adopt metric specifications when ordering supplies or commissioning buildings or initiating research, as soon as an industry was ready to start moving over to metric. This is in truth a very important aspect of Government policy in relation to the metric change. A program must therefore embrace the obligations which government must fulfill if the program is to be carried through to success.

"Some sectors of industry may indeed want the Government or the Metrication Board to lay down a target date for planning purposes. In other cases the industry itself may fix a tentative target date round which it can organize its thinking about what it will have to do to change over to metric. The practicability of the target date is then tested by analyzing what needs to be done, in what time scale and in what order. Here critical path analysis may prove a useful tool for analyzing the job to be done and getting the interrelated elements in the right time order. We in the U.K. are still struggling with this problem and this seems likely to be a continuing problem until the transition is substantially complete.

"It is not possible to generalize usefully about what the metric change involves. In its simplest terms it may mean no more than a shift of emphasis. Thus some corporations doing a great deal of their work in metric may tidy up the situation by going wholly metric. For most raw materials it may mean no more than changing the units in which the material is packed and sold and the basis of pricing. Again it is, of course, possible to measure in metric any product even when previously manufactured in customary units and the metric change may mean no more than changes in the measuring tools, the actual manufacturing process being unchanged.

"Again with services, such as freight transport, the physical operations are unchanged, but the freight rates and documentation are changed. If this was all that was involved in going metric, there would be no great trouble or costs, but and will reduce estimating costs, which are a large part of overhead.

Drywall contractors (plaster board) say metrication is impractical, with no benefits to offset transition costs. Metric boards, if thinner, would require costly fire tests.

General contractors and constructors, with 30 to 50 percent work now overseas, strongly favor metric, say increased production will offset transition costs. We should follow lead of England in standardizing building codes.

Home builders association sees considerable conversion costs and job-site problems with dual sizes, says conversion of codes and standards will take at least five years, but admits new standards could advance modular construction.

Lumber industry is not opposed and sees change as unavoidable, but expects transition costs to exceed benefits. Metric standards could eliminate "nominal" sizing insisted on by retailers.

Mobile home manufacturers now make 1/3 of all dwellings, split between members who say change would mean "chaos," to those who say "all should use this simpler system." Transition seems costly and confusing, but problems could be overcome.

Refrigeration and air conditioning manufacturers survey disclosed considerable opposition as well as substantial support for change. Need 10 years to convert if coordinated.

Road builders favor metrication as desirable and inevitable, but say conversion needs close cooperation in a planned program of education and encouragement, coordinated by the government.

Softwood plywood makers association says 1/3 members ready to produce metric sizes today, urges adoption of 1.2 x 2.4 meter panels used in England as opposed to DIN (German) 1.25 x 2.5 meter standard.

Wall and ceiling contractors (formerly plasterers) are not opposed if conversion is put on a 10-year basis. All technical documents will carry dual values by 1972.

Title insurance companies foresee high costs, no advantage in converting land title descriptions; if change is mandated, recommend conversion on a "go forward" basis when title changes hands. Metrication will affect assessment maps, deeds, mortgage documents, zoning maps, highway maps, tax records and easements.

equally, the gains from the change would be modest. This is probably true for a large part of the economy. Even in such an important area as agriculture, for example, going metric mainly means responding to changes introduced by suppliers and by marketing institutions and making changes in recording and accounting systems and in measures used for establishing in-puts and out-puts. This is not to say that there are no real gains from making these changes, but the most notable benefits are in the farm office while the operations in the field are not greatly changed. Even in retailing, the actual changes in the shop itself are very small. Most of the changes affecting retailing are in reality made by the manufacturer or distributor for it is there that the decision is made about the size and range of packs to be used."

It behooves us in the United States to examine very carefully what the British experience has been to date, and to take note of our distinguished visitor's reflections because they can save us much grief. However, we must also remember Mr. Bowen's opening remark about not drawing too close a parallel. Conditions in Great Britain, both political and economic, are different from those in the U.S. in the context of metrication.

For example, the British export trade is about 18 percent of their gross national product, a factor which makes British industry, as a whole much more keenly aware of international markets, economic conditions, and standards than U.S. industry. Our exports are only about four percent of our GNP. Second, Britain must be prepared to join the EEC (European Common Market) when and if the details can be worked out. To be a viable, influential partner, Britain must be on the metric system.

So, while on one hand, the motivation to convert comes from British industry, on the other hand the obstacles are greater than here in the U.S. Tradition has long been a much stronger factor in Great Britain, and even their money must be converted to a decimal system—no small task. Conversion of the traditional pounds, shillings and pence to a decimal system such as ours took place this February, so it is safe to say the British public is now aware of some of the problems of metrication.

Construction Industry Conference

Held at the National Bureau of Standards headquarters, Gaithersburg, Md., Oct. 5 and 6, 1970, the NBS Metric Study Conference on the Construction Industry heard 21 organizations present their views on metrication in the United States. Although opinions varied widely from strong opposition by four trade associations to strong support by five others, 21 spokesmen agreed that evolutionary metrication will not work and that a planned 10-year conversion program, coordinated by a Federal agency, is needed.

In general, most participants thought that metrication in the U.S. was inevitable, even when they could see no benefit. Six trade associations took a neutral stand, primarily because of conflicting responses from their members. The concept of the U.S. being an inch island in a metric world was new to many. Few people realize that the U.S. will soon stand alone. (See Part I, Dec. 1970, p. 36). All technical societies supported conversion, and were already taking steps to alert and educate their members by publishing dual values.

For a summary of how each group aresponded, see the box, pages 60-61.

Problems such as conversion costs were discussed, but as pointed out by Gordon Bowen above, they are very tough to pin down. Equipment problems generally were considered minor—less than for the manufacturing industries—since most changes can be made by adjustments or by routine maintenance within a year or two. Educating designers, title searchers, and on-site labor (see Part III of this se[illegible]ruary 1971, page 45, for construction workers opinions) will be major problems. The concrete block industry estimated a $2 billion conversion cost, but this was based on an overnight, mandatory conversion, a program not suggested by even the most ardent advocates of the change to metric.

Fairly typical of conversion problems were those itemized by the home builders:

- Cost of dual inventories, some maintained for many years
- Repair and maintenance of older structures with new, metric-size materials
- Reduced productivity, mixup of materials on the job site during conversion
- Time and cost of converting standards, codes, tables, and land titles

Changing land titles to metric units could be a headache, and would probably increase costs of a title search. But even though properties with recent descriptions in metric would have to be converted back for a search, the same problem is often faced today where earlier descriptions use units no longer common. Civil engineers, road builders, and title insurance groups agreed that it would serve no purpose to go back and change earlier records. Revisions to metric should be only on a "go forward" basis at the time a property changes hands.

Simplification, a major advantage, was discussed by several spokesman who mentioned earlier frustrating experiences in trying to get industry behind simplification of sizes and modular design on a voluntary basis. For example, the new approved softwood lumber standard, PS 20-70, calls for actual surface sizes of lumber on mill invoices to replace the nominal board-foot system. But retail lumber still opposes the standard and prefers calling a 1 3/4 x 3 5/8-inch stud a 2 x 4. A change to metric could provide the needed impetus.

Metric standards used in Europe for plywood and wallboard, and being adopted by the British, are quite close to our 4 x 8 ft. modular dimensions. Except for the Germans, the standards are 120 x 240 cm, or 47 1/4 x 94 1/2 inches, and adaptable to 30 or 40 cm stud spacing. The spokesman for the plywood industry pointed out that a change to 120 x 240 cm would be simple, but the German (DIN) standard of 125 x 250 cm (49 1/4 x 98 1/2) would be slightly beyond the capacity of most U.S. plywood presses, so it would be to our advantage to support the metric size adopted by all other European countries in international standard's work. Thickness is no problem—U.S. equipment can produce any metric dimension.

The wallboard suppliers have about the same problems for panel sizes, but although they too can make any thickness, the metric standard would have to be rounded slightly thicker than the inch equivalent, otherwise costly fire and sound tests would have to be repeated.

Since inch and metric standard paneling are so close in size, a means of identifying one from the other would be important during conversion. The concrete block people would have the same problem. Concrete block modules are nominally 8 x 8 x 16 inches, but actually a 3/8-inch allowance for mortar joint shortens both height and width. Established metric standards are 190 x 190 x 390 mm actual size; which for the height and width are almost identical to our inch module. The 190 mm thickness, however, is 13 mm less than 8 inches, so finished wall thickness could be a problem if the blocks were mixed.

William Burton, Conference chairman said in closing: "The inevitability of two years ago has foreshortened. All ISO (International Organization for Standardization) standards must now be in SI (International System) metric units, but dual values will be accepted in U.S. proposals. We need a national stan-

Participants in final EES conference

Transportation: Air Transport Association, American Institute of Merchant Shipping, American Trucking Association, American Warehouse Association, and the Association of Oil Pipelines.

State and Local Government: American Transit Association, City Management Association, Council of State and Local Governments, Institute of Traffic Engineers, National Association of Counties, Pollution Control Federation.

Public Health: American Dental Association, American Hospital Association, American Medical Association, American Nurses Association, American Optometrists Association, American Pharmaceutical Association, American Public Health Association, and the National Association of Retail Druggists.

dards body with power to represent U.S. capability in international negotiations. The Federal government must find a way to unify all U.S. standard making activity."

ANSI—ISO

Mr. Burton is chairman of the Metrication Committee, American National Standards Institute, Inc. which is the U.S. representative to the ISO. The ISO is the leading cooperative international agency, consisting of delegates from each country who thrash out differences in standards, then write and issue standards for each nation to accept (or reject) as truly national and international standards. Most nations accept these standards, since their representatives have participated in making them. Once an ISO standard is accepted, it can be a strong influence on international trade. If your product doesn't meet ISO standards, you have little chance to sell it outside of your own country.

Mr. Burton's point was that, whereas all other countries are represented by official government agencies, the U.S. delegates are from the ANSI which is a cooperative group, sponsored by, and inadequately funded by individual American companies. In order to increase its clout, it must have more substantial backing from industry, and official sanction from the U.S. government. And, of course, a U.S. commitment to convert to metric would greatly enhance its influence in helping to set ISO standards.

Incidentally, the ISO has just elected an American, Francis L. La Que, to the presidency for a three-year term starting Jan. 1, 1971. Mr. La Que is also president of the American National Standards Institute where, for many years, he has worked tirelessly to attain government and industry support for voluntary national and international standardization.

Final Conference

The seventh and last conference, at which Mr. Gordon Bowen spoke, was held at NBS headquarters in Gaithersville, Md. on Nov. 18-19. Labeled "General", it consisted primarily of nonmanufacturing service and professional associations in the fields of transportation, public health, state and local government, agriculture, mining, professional services, and "all others".

The 37 presentations brought no surprises, but they did contribute some new insights to problems already discussed at previous conferences. For example, the American Bar Association suggested a method for accommodating appropriate statutes and legal terms to the metric system using a computer retrieval system and temporary standardized amendments to cover existing laws.

In general, most of the groups recognized the need for the U.S. to go metric and believed it to be inevitable. No hard opposition developed, but of course, metrication would have little effect on many of the groups. But even those who saw little advantage to offset conversion costs indicated that "if it's good for the country, we will convert."

Groups in public health field were among the strongest supporters of metrication. The dentists, optometrists, and the hospital and pharmaceutical associations are all using metric almost exclusively today. The nurses and the retail druggists use dual systems, the American Public Health Association strongly endorses it, and the American Medical Association uses metric exclusively in medical research.

The agriculture and mining groups were much less enthusiastic about conversion, but would go along. The farmers groups see little advantage, neither do the foresters, commercial fishermen, nor the miners. The geological surveying group, however, would welcome the change because they now make land measurements using photometric equipment calibrated in meters, then must translate dimensions back into feet.

The transportation groups see some long range advantages and some short term problems during transition. Many are involved with international transportation and see metric usage continually increasing.

State and local government groups surveyed several state, county, and local governmental bodies, and found little strong enthusiasm or opposition. Most see some long range advantages, especially the traffic and transit association people. The Pollution Control Federation favors metrication, has been using it in labs and publications for years.

The professional services groups, bankers, lawyers, CPA's, credit bureaus and securities dealers will be least affected. In some cases, some numbering systems may have to be changed, such as units for cost accounting. However, the professional groups will be primarily affected as consumers, and so they are aware of the need for special education. ▲▲

Professional Services: American Bankers Association, American Bar Association, Associated Credit Bureaus, Associated Security Dealers, Certified Public Accountants.

Agriculture and Mining: American Agricultural Economists Association, American Mining Congress, Farm Bureau Federation, Geologic Survey, National Farmers Union, National Fisheries Institute, Society of American Foresters.

All Others: Metric Association, National Association of Broadcasters, National Federation of Independent Business, National Small Business Association, Package Machinery Manufacturers, Telephone Group.

article 5

Get ready for metric—part V

The evidence is overwhelming that we will have to join the rest of the world by converting to the metric system. Here's a final report on the seven NBS Metrication Conferences by the man who attended them all.

Robert W. Carson
senior contributing editor

The seven NBS Metrication Conferences, reported on in the preceding articles of this series, succeeded in bringing together all types of industries and professions to discuss the question of changing our measuring system to metric. Response was excellent to the invitations sent by Secretary of Commerce Maurice Stans to some 450 trade associations and professional societies, as well as more than 100 labor unions.

More than half of those invited brought meaningful comment that followed guidelines prepared by the U.S. Metric Study. Many contributions were based on extensive studies or detailed questionnaires of members. About one-third of the responses made minor contributions, and only a few ignored the invitation.

About half of the unions were apathetic or unconcerned. Some were opposed; one refused to participate because "the cost of changeover in tools, machines and containers will be billions." But several unions with metric experience felt that change was inevitable and should come soon.

Each group brought some special concerns, but in many important ways the reports were remarkably similar. For example, the contributions collectively showed that we are already much more metric than most of us realize:

- Calculations in the electrical and electronic industries have been metric from the start.
- All research in science (physics, chemistry, biology, health and nutrition) has been metric for years; all data in museums is metric; elementary and high schools use metric units in modern science courses.
- The pharmaceutical industry went metric 15 years ago.
- Industries with sales abroad make general use of dual dimensioning showing metric equivalents for inch dimensions on engineering drawings and sales brochures.
- Imported automobiles, engines and transmissions are largely metric; most auto repair mechanics have metric wrenches.
- Ball bearings are metric in two-thirds of today's production.
- Photographic film is made to metric widths, and threads on spark plugs are metric.

Change is inevitable

A strong majority of all the reporting groups said that change was inevitable because the advantages outweighed the disadvantages. Substantially all those favoring metrication preferred a national program coordinated by a government agency. Nearly all favored a 10-year coordinated conversion period.

Beside the advantages offered by the metric system itself, a number of other advantages accompanying the change were cited: the opportunity for design improvement in redesign for metric; elimination of needless sizes and types of products, conversion of clothing and shoe sizes to a system using body dimensions.

Even the minority that could see little benefit to them in metrication accepted the change as inevitable because of the advantages the metric system offered the nation—now an inch island in a metric world.

Surprisingly few of the "inevitable" advocates seemed concerned with the impact of metrication on foreign trade or balance of payments. But some saw wider markets for exported products, and advantages in

An English view of converting their pounds and shillings to metric (decimal) this past February

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"How clever! Now what would all that come to in REAL money?..."

world-wide interchangeability, and a wider range of choice provided by metric imports.

Among opinions expressed by members of a group, a few questioned the motives behind the study. Some suggested it was a "Communist conspiracy" or a scheme by manufacturers to raise prices.

If a change is made almost all prefer a voluntary program with a careful ordering of priorities under guidance of a Federal agency such as NBS. A few want legislation for a mandatory program that would require all industry and trade to change by a fixed date. Others pointed out that not all sectors or industries will need to change over, and certainly not all at once.

How did we get in such a fix?

It goes back a long way. The English foot started as the length of a man's foot, and the inch was the width of his thumb, and 12 inches made 1 foot. The yard was the distance from the tip of a man's nose to the end of his outstretched hand, and was equal to 3 feet.

Our weight standards grew out of the English "stone" which came from the Babylonian equal-arm balance with a set of stones for standards. But in England the size of the weight varied with its use; the stone for weighing a horse was 14 pounds; for measuring wood was 16 pounds; for weighing meat, 8 pounds. For smaller weight units the English borrowed the "grain" from the Greeks who used a grain of wheat as their basic unit; 420 grains made an ounce (troy weight) and 16 ounces made 1 pound. The Arabs used the karob for weighing gold and precious stones, from which came the carat—now standardized as 1/5 gram, and thus related to metric.

Back in the 12th century, the English began to standardize the system we now use. But we inherited not one, but three systems of measuring mass: the avoirdupois, which is the familiar 16 ounces to a pound with 437.5 grains to an ounce; the troy, which includes 3.168 grains to a carat, 480 grains to an ounce and 12 ounces to a pound; and the apothecaries', which includes 20 grains to a scruple, 480 grains or 24 scruples to an ounce and 12 ounces to a pound. The avoirdupois pound weighs 453.5924 grams, whereas both troy and apothecaries' pounds weigh 373.24177 grams.

Europe in time developed systems and standards that were different from English, and varied from city to city. In 1790, to end this confusion the French academy proposed the metric system with only one name for a basic quantity and a decimal system for larger and smaller units. In addition, these basic quantities were interrelated. For example:

The meter for length was 1/10 millionth of a quadrant of a meridian circle. The gram was the mass of 1 cubic centimeter of water. The temperature unit was 1/100 of the difference between freezing and boiling points of water.

This was the cgs metric system, as it was introduced in 1790. When Thomas Jefferson, a scientist at heart, became President, he tried to get the Congress to adopt it, but was turned down because it was a "French" invention. If he had succeeded we would have been the first nation to adopt metric.

But Napoleon imposed it on France and the French Empire. Later when Germany, then Italy became nations, they were already using metric. In 1875 a treaty establishing international standards for metric weights and measures was signed by 17 countries including the U.S. Then the Scandinavian countries, Russia and Japan replaced their systems with metric, and other industrial countries followed.

England is converting to metric now, Australia is starting a 10-year project, and Canada is committed to metrication. So the U. S. is the only major industrial country not metric today, sharing this dubious honor with Ceylon, Gambia, Guyana, Jamaica, Liberia, Malawi, Nigeria and Sierra Leone. Truly, we are "an inch island in a metric world."

The maturing of metric

The original definition of the basic meter length was inconveniently related only to a master standard bar, and length was replaced some years ago by a specified number of wavelengths of highly constant radiation from a krypton arc. Then, by international agreement (including the U. S.) the English inch was shortened by a few millionths to equal exactly 25.4 millimeters to simplify conversion. The inch thus became based on the meter.

Some inconsistencies still remained in the cgs metric system. For example, there were two different kilograms, one for force and one for mass, and a variety of units for energy and work. In 1960 the European Common Market countries agreed on a modernization of the metric system, called SI, or System Internationale. The kilogram was assigned to mass alone, and the newton as the unit of force. The joule became the one term to use for energy, and watt for power. Pressure and stress are measured in newtons per square meter.

Some other cleaning up was done on the system, but the second as the unit for time, and the degree as a unit for circular measure were not changed. Earlier efforts to introduce decimal multiples in these two areas were not successful. But metric clocks number the hours from 1 to 24. This SI or "matured" metric is the system that has now become the world standard. It is the system England is now adopting, and that Australia and Canada are changing to.

Our lagging efforts

Many attempts have been made over the years to get the U. S. to replace our archaic English system with metric. We made it optional in 1866, and almost adopted it in 1902. During World War I some scientists tried to get Congress to adopt metric to aid in working with our European allies, all metric except England. Again, it was defeated on a highly emotional basis. A leading publication in the manufacturing field in an editorial said "No one could fight more effectively for the Kaiser than to force through a compulsory metric law. If such a law is passed we will have lost the war. . ."

More recently, in 1964, a bill to replace our customary system with the modernized SI metric aroused the same old emotional arguments: it would cost billions; we would lose our dominant world position as machinery builders; people would not accept a foreign system. Besides, our system was better; let the rest of the world change to our system.

Many specious arguments were rekindled. We would have to tear up all railroad tracks and re-lay them; all land would have to be resurveyed; all machine tools scrapped. The dairy industry said it meant throwing away billions of milk bottles, and a 500-gram package of butter would be smaller than a 1-pound package and thus reduce sales.

The bill died, as it had in earlier years, but its sponsors rewrote it to call for a study to determine the facts: how much it would cost to convert to metric, and how much it would affect industry and trade. The bill directed the Secretary of Commerce to make the study and report the facts to the Congress in three years. Just then, the British announced their decision to metricate in a move that was sponsored by British industry, and this changed the picture.

Metric Study Act

In 1968 the study bill was passed, and the Secretary of Commerce handed the study project to the National Bureau of Standards which set up the U.S. Metric Study Group to get the facts on where we stand.

To assemble all the factual information required by the Metric Study Act, the U.S. Metric Study Group started separate projects:

1. A survey of 4000 manufacturers on the impact of converting their measurements to metric under a coordinated national program.
2. A detailed cost analysis of metrication in 100 firms.
3. Telephone survey of a random sample of 3000 nonmanufacturing firms on the impact of metrication on their operations.
4. Study of the effect of a 10-year conversion plan on the Department of Defense.
5. Survey of 35 other Federal agencies on a similar basis.
6. Statistical study of current international trade at 750 firms exporting measurement-sensitive products.
7. Analysis of the metric debate in the U.S. over the years.
8. Cost of adapting commercial measuring and weighing devices to metric units.
9. Effect of metrication on State and local governments.
10. Impact of change to metric on the educational system.
11. Sample survey of 1400 representative family units to determine the impact of a coordinated national change to metric.
12. Effect of metrication on labor in a study conducted in cooperation with AFL-CIO.
13. Comparative survey of selected engineering standards and their international counterparts.
14. The series of seven National Metric Study Conferences mentioned earlier, to obtain comment from trade, professional, and labor associations on the fundamental issues of the National Metric Study.

Cost of conversion

Contributions to the metrication conferences showed that transition will be costly in manufacturing industries where metrication will involve substantial redesign, modification or replacement of manufacturing equipment and manufactured products. Two other areas will face lesser problems: in non-

[illegible]

If you ask the right questions, you get significant answers. In preparing for the seven metrication conferences, the National Bureau of Standards asked everyone it could reach in U.S. industry the right questions. The report from each participating group was based on the following:

Questions

- **What is the present impact within the U.S. of increasing worldwide use of the metric system?**
- **What would be the impact in the future—assuming no change in current metric usage and no coordination among various sectors of society?**
- **What would be the effect of a coordinated national program to increase the use of the metric system?**

The answers

In capsule form, this is what NBS heard at the conferences:

- **The U.S. is slowly going metric by evolution. The longer it drags out, the more painful and more costly it will be.**
- **The price of staying with the "English" system will climb, especially because as the U.S. very slowly evolves to metric, use of double standards will increase, imposing both monetary and human costs on our society. In addition, we will slowly be squeezed out of world markets as ISO product standards are adopted.**
- **A coordinated national program is our only visible alternative. Properly managed, it will keep costs of conversion at a minimum and will keep the transition orderly.**

For more specific details on each conference and a summary of how each group answered the questions, see the preceding four articles:

We can't lick 'em, so we'd better go metric—see *Machinery*, Dec. '70, p. 36—the engineering-oriented industry conference held at Deerfield.

The whole world is going metric—Part II *Machinery*, Jan. '70, p. 46—the Education Conference, which included representatives of primary and secondary school teachers and administrators, college professors and vocational education experts.

The whole world is going metric—Part III, *Machinery*, Feb. '71, p. 45—three conferences: consumer-oriented industry, consumer affairs and labor.

The whole world is going metric—Part IV, *Machinery*, April '71, p. 58—two conferences: construction industry and the General conference which was primarily "service" oriented, including transportation, government, public health, legal, accounting, mining, agriculture and "all others."

manufacturing industries where dual stocks of materials and repair parts will be needed, and in consumer education and worker retraining.

Some estimates of conversion costs in manufacturing were in the billions, but were based on a mandatory overnight changeover, with wholesale replacement of current production equipment, a situation not contemplated in the Metric Study Act.

Conversions costs in manufacturing industries can be minimized if the transition time is long enough so tools and equipment can be replaced when wornout or obsolete. In some industries five years will be long enough; in others it may take 15 years or longer. But most reports indicated that a 10-year transition would hold costs to a minimum. England's experience shows that anticipated costs and dislocations were greatly exaggerated. Further, innovation or improvement accompanying metrication often accounted for more equipment cost than metrication alone.

Working off existing inventories can incur substantial transition costs unless conversion time is sufficient to allow normal turnover. Material sold in bulk can be converted with no delay after metric scales and containers are ready. Fresh foods may require a few weeks; packaged foods a few months. Hardware and building supplies will take much longer.

Dual inventories required during the conversion period, and for years more in some situations, will need careful coordination to keep costs to a minimum. Service needs on long-life equipment such as machine tools and major appliances may run several years beyond the end of the conversion. Repairs to buildings may also require small-scale production of inch-based supplies for years.

Building codes and food legislation will have to be revised—estimated to take about five years. School textbooks are usually revised about every five years, and change to metric will not add to costs for a five to 10-year transition. Traffic signs and road markers could be converted over a year or two, but speed limit signs would have to be changed overnight everywhere. Land titles could be converted on a go-forward basis when property changes hands.

Other one-time transition costs will include retraining workers, revising standards and drawings, and some worker inefficiency.

Production workers who are machine tenders will need no special training other than what they will receive as consumers. But maintenance men and service employees will need basic training in the metric system and some new metric tools. Some skilled workers will need more training and will face greater expense for worker-owned metric tools.

The AFL-CIO has taken a firm stand that legislation for metrication must include reimbursement of workers for metric tools they must buy, and must also provide training needed at no cost to the worker.

Some office workers will need metric training. Retail store clerks must be trained to assist customers. Teachers will need special in-service training to prepare for metric instruction. Some estimates for training time appeared exaggerated; most educators felt that employee training would not require more than a week.

Larger one-time transition costs will be faced in converting engineering drawings, repair manuals and sales literature for products changed to metric. Engineering standards must be revised, including design tables and calculations, before metric products are made. Manpower needed will add to transition costs.

Public education a major task

Nearly every one of the conferences produced comment on the need for a broad plan of consumer and public education to the metric system. Children now in school will face no problem if metric is started in the 1971-72 school year as proposed by the National Education Association. Workers receiving training on the job will be prepared as consumers, but a massive program will be needed to reach most consumers.

The Advertising Council is laying plans for a public service advertising program to popularize metric on TV and in magazines. Public museums are ready with displays on the metric system and its advantages, and the toy industry is ready to market toys and games that could help teach metric. Vocational schools will be prepared for consumer classes as well as up-grading courses for workers. In England, local volunteer groups organized to help bring the metric message to consumers.

Some educators suggested introducing dual values at the start of transition. The customary value would be used first with metric equivalent in parentheses; after awhile the order would be reversed and finally the customary value dropped. Other educators preferred a "total immersion" program of metric only just as soon as metric products and packages appeared in stores.

Current experience in England should be a good guide for us in many ways. Their problem was compounded by a change to metric currency, but they report that people can and do adapt when they put their minds to it.

What should you do now

How can your plant prepare for this inevitable change? First, you must get the facts; find out what the change to metric will mean to your company. Ignore opinions, and don't worry about the problems other plants or industries will face; let them handle their own problems.

Do two things. 1) Get your trade association to make a study, and 2) set up a Metric Study Committee in your own plant.

Charge your Committee to:

- Determine the current use of metric in your present operations.
- Find out how much it will cost to convert tooling, equipment and products on an assumed 10-year basis. See where a shorter conversion time can be accepted.
- Determine what standards, procedures, drawings, calculations and computer programs will need to be changed; what sales literature and instruction manuals.
- See what special training will be needed and how it can be provided at minimum cost and disruption to clerical and production workers, quality control, engineering, accounting and supervision.
- Study priorities in changeover. Where will changes in the plant have to be made first. Which suppliers will have to change before you can. Which customers will have to wait for you to change before they can.
- See what steps you can take now in preparation for conversion.

Use this study as a means of alerting key people in your plant to the coming change to metric. Let the committee ask for information that will require some study. Pass around information on SI metric; circulate data from your trade association on the NBS Study and articles such as this series in *Machinery*. ▲▲

*Editor's Note: Since Great Britain is halfway through a 10-year conversion program most industrial plants have adopted programs to facilitate transition within their own organizations. In appropriate subsequent issues, we plan to publish articles on some of these transition programs: how some particular companies organized, what was successful, what failed and why.

U.S. stand on international standards [illegible]

The Secretary of Commerce has transmitted to Congress the first interim report from the U.S. Metric Study, [illegible]

The report of the [illegible] [illegible] the U.S. [illegible] following recommendations:

1. The Department of Commerce should take appropriate steps to determine whether the [illegible] part of agreements such as the [illegible] Agreement can be expected to affect the U.S. balance of payments significantly or otherwise work against the best interests of the United States.

2. The Department of Commerce should devise, in concert with other interested Federal agencies and the responsible standardizing institutions, a firm U.S. policy about participation in international standards activities, including what role the Government should play and provisions for furthering the public interest as well as the competitive position of U.S. industry in world trade.

3. If such a policy dictates increased participation, appropriate steps should be taken to see that such participation is sufficient to meet the rapidly increasing international standardization activities that have been predicted for this decade.

4. The Department of Commerce should, in concert with other interested Federal agencies, initiate action to determine whether or not the United States should participate in international product certification agreements. If adherence to such agreements is deemed desirable, an appropriate mechanism for certification within the U.S. should ensure that an appropriate alternative strategy is devised and followed.

5. Finally, the actions indicated above should be taken without awaiting the outcome of the U.S. Metric Study, but drawing upon it for relevant information.

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